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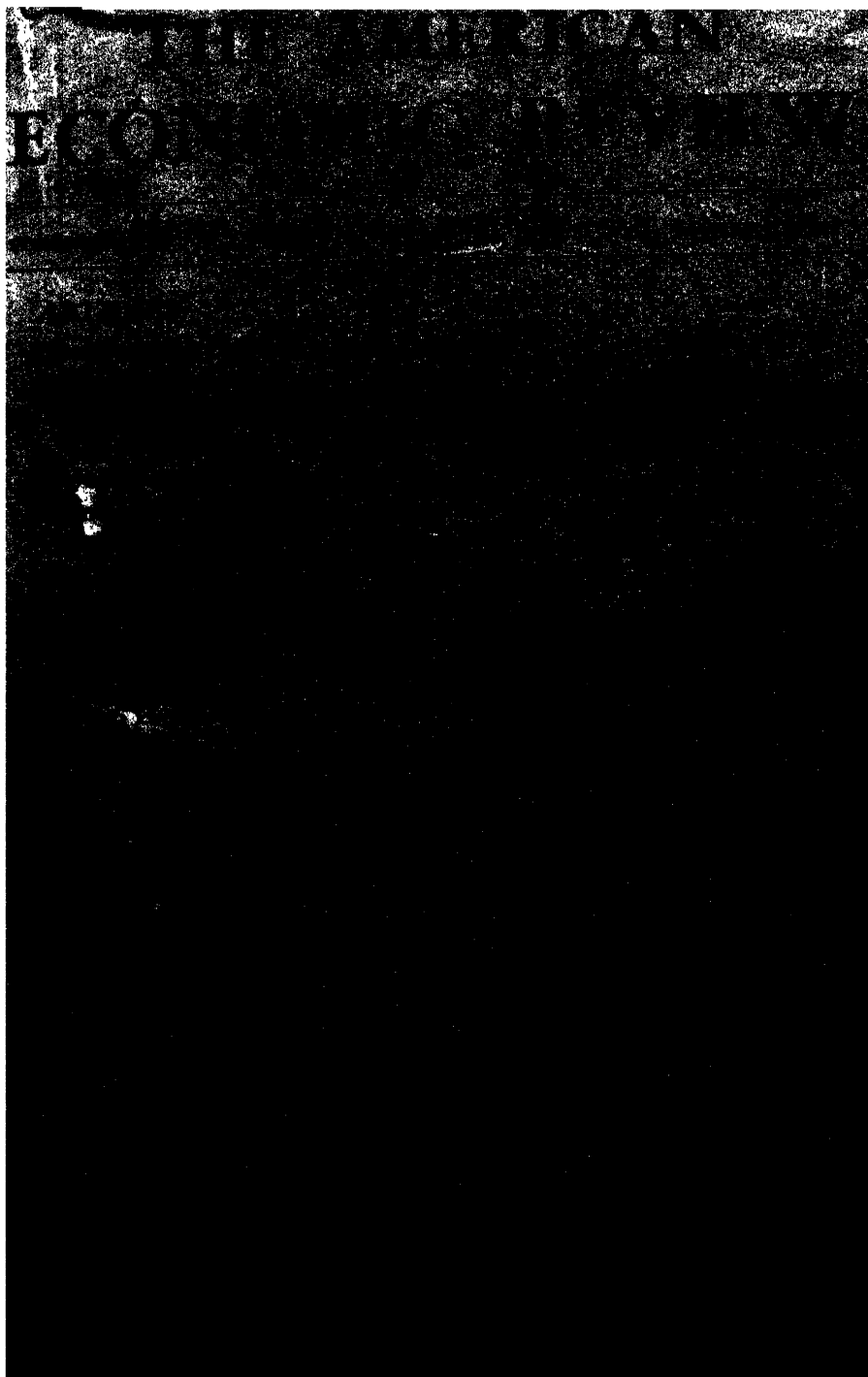
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## JACOB MARSCHAK

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Jacob Marschak has inspired several generations of economists by the wide range of his intellectual interests, the penetration and wit of his many writings, his innovating drive in directing research on both sides of the Atlantic, his wisdom and human effectiveness as a leader of discussion, and his unflinching adherence to the highest scientific ideals.

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# The American Economic Review

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## PLANNING IN A SURPLUS LABOR ECONOMY

By LOUIS LEFEBER\*

In a planned economy where decision making is at least partially decentralized, the coordination of the diverse production and investment decisions with the aggregate national development plan is a fundamental problem of planning. In particular, if the free market prices are inconsistent with the social goals, the market-determined outputs of goods and services and the division of effort between production for current and future consumption will be less than socially optimal. This is obviously the case if the conditions for competitive pricing are not satisfied, i.e., if there are increasing returns to scale in production or certain externalities and imperfections whose effects on pricing are not corrected by government intervention. But even if all the necessary conditions are met, it is well known that pure competition will still not lead to a socially optimal resource use if the distribution of income is not socially optimal. This is likely to be the case in a labor surplus economy in which the supply of labor is infinitely elastic at institutionally determined minimum wage rates.<sup>1</sup>

\* The author is professor of economics, Brandeis University. This paper was prepared for and is reproduced with the permission of the United Nations Industrial Development Organization, United Nations, New York (formerly the United Nations Centre for Industrial Development). The views expressed represent my own. I am indebted to Mr. Vishal Sabherwal, of the Indian Statistical Institute, for his statistical and computational contribution and to the Research Center in Economic Growth of Stanford University for generous provision of computational and other facilities. Also, since this paper is a continuation of some of my research undertaken during my Ford Faculty Research Fellowship, I take this opportunity to express my continued appreciation to the Ford Foundation. Finally, I should like to thank Stephen Marglin for our discussions on this and related topics from which I have greatly benefited, and Kenneth Arrow, V. K. Ramaswami, Maurice Scott, and T. N. Srinivasan for their useful comments on an earlier version of this paper. None of them should be held responsible, however, for my errors.

<sup>1</sup> There is a growing body of literature on the welfare analysis of labor surplus economies. Here Sen's contribution [12] should be mentioned, as well as Marglin's recent monograph [8] which provides, in addition to an exhaustive discussion of the literature, an advanced analysis of optimal growth in labor surplus economies. Both Sen and Marglin confine their analysis, however, to one-sector economies which limits the generality of their policy conclusions. This is significant, because—as will be shown below—relative sectoral factor intensities can have an important and occasionally decisive role in the conduct of wage and employment policies. A multisectoral analysis is presented in Lefebvre and Chakravarty [5] which is, however, confined—at the cost of excluding other welfare alternatives—to the derivation of time-minimizing routes to full employment.

The method of income redistribution suggested by neoclassical economics consists of a neutral personal tax-subsidy scheme, i.e., a direct transfer of purchasing power among individuals. But even apart from the problem of neutrality, such schemes cannot be relevant if no institutional means exist for their implementation as is typically the case in underdeveloped surplus labor economies. There the most important if not the only means of redistribution may consist of increasing the rate of employment.

If a positive wage rate is fixed in an unemployment economy but markets are otherwise free to adjust, competitive free market hiring will be carried to the point where the value of labor's marginal product is equal to the given wage rate. Then, if profit maximization is undertaken for the purpose of generating the largest feasible investable surpluses, the competitive free market process leads to the fastest attainable rate of economic growth. In the process unemployment is absorbed as fast as possible, but current employment is restricted to just that level needed to stay on the maximal growth path.<sup>2</sup> In this case consumption is only an intermediate activity with the function of physically sustaining the labor engaged in producing for the future. It can be shown, however, that if society values redistributed current consumption also per se, competitive free market processes result in a lower rate of employment and a higher rate of investment relative to current consumption than justifiable on social welfare grounds. Furthermore, if it is the rate of investment which is being held constant and the institutional wage rate is a policy parameter, a higher rate of employment and consumption may be attained by a planned and controlled allocation of resources than by market competition.

Two points need to be mentioned. First, for the attainment of a welfare optimum, intervention in the market process may be necessary. This is so because in the short run, when the stock of other resources is fixed, raising employment above its competitive free market level necessarily lowers labor's marginal product from equality to below the fixed wage rate. Hence, profit maximizing entrepreneurs can be induced to exceed the free rate of hiring only if the difference is made up to them by a suitable payroll subsidy. Second, since an induced increase in the current level of redistributed consumption may result in lowering the rate of investment and, consequently, the rate of growth of employment and consumption, each form of intervention—as well as non-intervention—implies a social judgment about the desired balance between current and future welfare.

These observations give a clue as to what types of models are suitable for planning in surplus labor economies. First, since the current level

<sup>2</sup> See Lefebvre and Chakravarty [5].

and the rate of growth of employment are of central welfare interest, the model structure must explicitly recognize the relationship between employment, consumption, and growth. Second, if the model is expected to yield, along with a plan, policies for decentralized implementation, the family of alternative plans which can be generated by the model must also include the free market solution.<sup>3</sup> Only in that case can the differences between the price structure associated with the latter and the desired welfare optimum be directly observed and the decentralized means for sustaining a nonmarket solution deduced. Third, the alternative plans must be derived in response to clearly stated relative preferences as to current and future welfare. These can be incorporated into a social welfare function which in the simplest case reduces to a set of relative weights for consumption and investments.<sup>4</sup> In any case, the price relationships from which policies for plan implementation are deduced must be functions of relative social preferences.

At one extreme, it is conceivable that no weight would be placed on growth so that current consumption would be maximized. This necessarily implies stagnation either in absolute or in per capita terms.<sup>5</sup> At the other extreme there is the already mentioned possibility of wanting to maximize the growth of consumption or employment without concern for temporal welfare.<sup>6</sup> It is more than likely, however, that social preferences—whatever they may be—will lie between these extremes.<sup>7</sup> Hence, any model to be used for planning should have the corresponding capacity of generating all relevant intermediate solutions.

### *I. The General Argument*

In this discussion, a state of surplus labor is said to exist when (1) given any wage rate, there is an incipient redundancy of labor; or (2)

<sup>3</sup> Hence, the planning model must be of the optimizing type. However, optimization alone does not insure the existence of a free market analogue. This depends on the structure of the model, i.e., the specification of the objective function and other constraints. For instance, models whose objective functions include certain strategic variables (e.g., foreign investment) or have arbitrarily specified growth rates during the plan or in the post-terminal period, cannot generate solutions which represent free market analogues.

<sup>4</sup> The general form of social welfare function should have as its arguments both the absolute levels and the rates of change of the relevant variables. However, in the context of planning the substitution of the rate of investment for the different growth rates may be defensible not only on pragmatic grounds but also in terms of the analytical structure underlying most planning models. Specifically, if investment and capital stock are homogeneous, the substitution of the rate of investment for particular growth rates in the social welfare function leaves steady state growth solutions unaffected.

<sup>5</sup> If the objective is the maximization of some present discounted value concept of consumption, it can lead to growth only to the extent that the productivity of investment exceeds the discount rate (see Chakravarty [1]). Then growth may have to be forced by constraints to obtain minimum rates of increase, as in Chakravarty and Lefebvre [2] and in Eckaus [4].

<sup>6</sup> See Lefebvre and Chakravarty [5].

<sup>7</sup> See Marglin [8] who forcefully makes this point.

given a particular institutionally determined wage rate, full employment cannot be attained by competitive *free* market processes.<sup>8</sup> Both of these definitions are consistent with the classical Marx-Lewis concept of an infinitely elastic labor supply at a given minimum wage rate.<sup>9</sup> Furthermore, both refer to a short-run state: in either of the cases full employment may be attained in the long run if the rate at which unemployment is absorbed exceeds the rate of growth of the labor force. The second definition is the more interesting, however, since it does not exclude the possibility that government intervention in free market processes may establish full employment even in the short run. For this reason, unless otherwise indicated, I shall always discuss the broader case covered by the second definition.

In such an economy let us assume that two goods, investment ( $I$ ) and consumption ( $C$ ), are produced by labor ( $L$ ) and capital ( $K$ ) which at the initial time period are available in given fixed quantities and that the institutionally given real wage rate ( $\bar{w}$ ) is specified in terms of the consumer good.<sup>10</sup> Let us further assume that consumption by rent earners is included in  $\bar{w}$  in the form of a surplus of given fixed proportion and that labor does not save from its wage income.<sup>11</sup> In this way profits, already net of consumption, can automatically flow into savings and with  $\bar{w}$  given the minimum amount of  $C$  produced in the economy is determined by the rate of employment ( $E$ ).

Now the economy can be described by the following relationships:

- (1)  $I = F(K_I, L_I);$
- (2)  $C = f(K_C, L_C);$
- (3)  $\bar{w}(L_I + L_C) = \bar{w}E \leq C;$
- (4)  $K_I + K_C = K(t);$
- (5)  $L_I + L_C = E \leq L(t) = L_0 e^{nt}.$

Relationships (1) and (2) are the production functions; (3) states that the output of  $C$  cannot be less than the wage demand for consumer goods; (4) and (5) show the distribution of capital and labor between

<sup>8</sup> This definition does not preclude certain potential ambiguities which will be clarified in the analysis.

<sup>9</sup> Arthur Lewis [6] was the first to introduce, after Marx, the concept of an infinitely elastic labor supply. For a neoclassical analysis of Marx-like systems see P. A. Samuelson [11].

<sup>10</sup> I shall assume throughout the analysis that production is subject to the law of constant returns to scale. However, the argument in Part I—except the analysis of growth—would remain unaffected if diminishing returns were to be assumed.

<sup>11</sup> I.e., consumption by capitalists is a function of employment. Alternatively, capitalists' consumption could be made proportional to the total amount of capital in use, so that profits would again represent a figure already net of consumption. The more neoclassical assumption that capitalists' consumption is a function of profits may or may not be more realistic, but in either case, it would interfere with the simplicity of the analysis.

the two processes at time  $t$ . It is reasonable to assume that capital is scarce, hence (4) will always be binding; however, (5) leaves open the possibility that total employment  $E$  could be smaller than the potential labor force  $L$  which is growing at the rate  $n$ . If at the given wage rate  $\bar{w}$  the supply of labor is infinitely elastic, (5) must be an inequality by definition.

To be sure, the above relationships do not provide a basis for the selection of the desirable output combination; however, for any stipulated  $\bar{w}$ , the alternatives open to society can be derived. To this end different outputs of  $C$  can be held constant and to each the corresponding highest feasible output of  $I$  can be computed from relationships (1) to (5). On the other hand, if the weights society places on current consumption and investment can be identified, the socially optimal output combination and the corresponding resource allocation can be directly deduced. Assume—as it will be shown below—that such weights can be identified and are denoted by  $P_C$  and  $P_I$ . In that case the weighted sum of the outputs (net national product valued at welfare prices) can be written as

$$(6) \quad Y = P_C C + P_I I,$$

which, if maximized subject to the constraints (1) to (5), yields at any given moment of time the optimal values of  $C$  and  $I$ .<sup>12</sup> By varying the weights all alternative maximal output combinations can also be obtained so that the temporal alternatives open to society can be derived by this method also. The resulting relationship is the production possibility frontier between  $C$  and  $I$  which can be written as

$$(7) \quad I = I(C; \bar{w}),$$

and will be referred to as the *feasibility function specific to  $\bar{w}$*  or  $FF\bar{w}$ . Since  $\bar{w}$  is a parameter subject to arbitrary choice, (7) represents a family of production possibility functions, one for each institutional wage rate. The question is then: how do the members of this one-parameter family of feasibility functions relate to each other? It can be shown without any formal argument that all of them are bounded by a transformation function which is derived as if the wage rate were determined by free market competition and not institutionally specified.

### 1. The Social Transformation Function (STF)

If society were not to fix an institutional wage rate (i.e.,  $\bar{w}=0$ ), then (3) would naturally remain nonbinding and the other four relationships,

<sup>12</sup> If it is stipulated that in the solution all variables must be non-negative and that both production processes are subject to the law of constant returns to scale, then the solution of (1) to (6) can be readily characterized by the method of parametric programming. See [3].

i.e., (1), (2), (4), and (5), would define a regular neoclassical guns-and-butter production possibility surface. This I shall refer to as the social transformation function (or STF) because, as will become evident, it is the boundary relationship referred to above.

If there is no incipient redundancy of labor, i.e., if (5) is binding, the STF is a smooth, convex surface, such as the arc  $AG$  in Figure 1.<sup>13</sup> Then, if there exists a set of welfare weights,  $P_C$  and  $P_I$ , the output combination which maximizes the value of (6) is found at the tangency of the STF and a price-income line whose slope is defined by the ratio of the weights.<sup>14</sup> Corresponding to this output combination the solution provides a set of competitive market prices which also includes a free market wage rate. So as to differentiate the latter from an institutional wage rate, it will be designated by  $U_{\bar{w}}$ . It is obvious that this market wage rate must be zero when labor is redundant and positive when labor is scarce (i.e., if on the STF the marginal product of labor is positive when fully employed). In either case, as a condition of competitive equilibrium on the STF, labor must be so allocated as to equate the value of its marginal product in all activities to this wage rate. Hence, when  $\bar{w}$  is zero, we can write

$$(8) \quad P_C f_L = U_{\bar{w}} = P_I F_L;$$

where  $f_L$  and  $F_L$  represent the marginal productivities of labor in the production of  $C$  and  $I$  respectively. An exactly analogous expression exists for capital which, if  $\bar{w}$  is zero, is identical to the condition of capital allocation in a competitive *free* market system.

## 2. The Feasibility Function Specific to a Given Wage Rate ( $FF_{\bar{w}}$ )

Now consider the case of a positive institutional wage rate fixed in real terms at, say,  $\bar{w} = w^*$ . Relationship (3) now becomes relevant. Specifically, we are advised that, if production is to take place on the STF, the output of  $C$  must be at least as great as the wage-consumption demand of the fully employed labor force, so that to satisfy the latter

<sup>13</sup> The greater the total labor endowment relative to the capital stock, the "flatter" the transformation function. In the limit—if constant returns to scale production functions themselves have clearly defined regions of redundancy—the transformation function between  $C$  and  $I$  must be a straight line. This is so because then  $K$  is the only scarce input which, as long as the wage rate is zero, is always utilized with just the amount of labor sufficient to lower the marginal product of labor also to zero.

<sup>14</sup> The price-income line is obtained by rewriting (6) in the form

$$C = Y/P_C - P_I/P_C I$$

where  $Y/P_C$  is the intercept on the  $C$  axis and represents the value of the national product in terms of  $C$ . If the STF is a straight line function, then a linear maximand, such as (6), could not yield a determinate solution at other than vertex points. In that case a nonlinear welfare function or objective function such as discussed below, is necessary for a determinate solution.

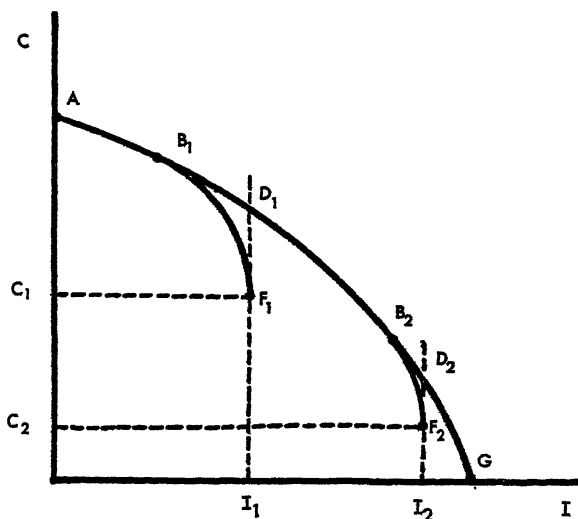


FIGURE 1

there must be some feasible minimum output of  $C$ , function of  $\bar{w}$ . This is found at that point on the STF where (3) just turns binding, i.e., where  $w^*L(t) = C$ .<sup>15</sup> If this takes place at point  $B_1$  in Figure 1, then it is obvious that the feasible segment on the STF consists of the arc  $AB_1$  representing either a part or the totality of the  $FFw^*$ , and that the arc  $B_1G$ , being nonfeasible, is irrelevant.

But what if society desires a higher rate of investment than feasible at  $B_1$ ? If the wage rate could be lowered below  $w^*$ , (3) would cease to be binding at  $B_1$  and more  $C$  could be sacrificed along the arc  $B_1G$  for increasing the output of  $I$ . Assume, however, that the wage rate is being maintained at  $w^*$ . Then consumption can be further reduced only if the rate of employment itself is *pari passu* diminished. It follows that if the output of  $I$  can at all be increased above its level at  $B_1$ , production will have to take place below the STF.

It has to be demonstrated, however, that the sacrifice in consumption and employment can be matched by a compensatory increase in investment, i.e., that the  $FFw^*$  can have a continuation below the STF, as illustrated by the arc  $B_1F_1$  in Figure 1. On this point we can reassure ourselves by comparing the changes in the supply of and demand for  $C$  at  $B_1$  which occur if the marginal unit of labor is removed from the  $C$  sector. The loss in supply is the marginal physical product ( $f_L$ ) and the reduction in demand corresponds to  $w^*$ , both measured in units of  $C$ . At  $B_1$  the following three possibilities exist:

<sup>15</sup> Given a sufficiently high  $\bar{w}$ , there may be no feasible point on the STF. I shall assume, however, that this is not the case.



$$(9a) \quad f_L > w^*; \quad (9b) \quad f_L = w^*; \quad (9c) \quad f_L < w^*.$$

Clearly, (9a) must be irrelevant to a surplus labor economy. The removal of the marginal unit of labor would reduce the supply of  $C$  by more than the wage demand. In such circumstances an increase in the total labor force without any change in the capital stock could lead to an increase in both wage-consumption and investment, a result inconsistent with the phenomenon of surplus labor.<sup>16</sup>

The case of (9b) cannot be dismissed as irrelevant. However, since the drop in the supply caused by the removal of the marginal unit of labor would just match the corresponding drop in the wage-consumption demand, no resources could be released from the  $C$  sector for use in the production of  $I$ .<sup>17</sup> It follows that the output of  $I$  cannot be raised above what is feasible at  $B_1$  and the  $FFw^*$  consists of the arc  $AB_1$ . The significance of this case is that it represents the knife edge between the states of full employment and surplus labor. However, if  $w^*$  is arbitrarily selected the likelihood is infinitesimal that (9b) should be satisfied at the same point where (3) turns binding; hence, the relevance of this case is theoretical rather than practical.

There remains the case of (9c) which does provide the opportunity of a tradeoff between consumption and investment. Here if the marginal unit of labor is retired into unemployment, the demand for  $C$  is reduced by a greater amount than the supply of  $C$  so that some resources can be transferred from the  $C$  into the  $I$  sector. Furthermore, as long as  $w^*$  exceeds  $f_L$ , this same procedure can be continued. However, because the capital stock is constant in the short run, as the rate of employment decreases, the capital labor ratio and labor's marginal product in both occupations *pari passu* increase.<sup>18</sup> As a consequence, the gap between  $f_L$  and  $w^*$  diminishes and the rate at which resources can be released from the  $C$  for use in the  $I$  sector also diminishes. This is illustrated by the arc  $B_1F_1$  in Figure 1, where the marginal rate of transformation keeps increasing until it reaches the vertical just when  $f_L$  becomes equal to  $w^*$ . At that point nothing could be gained from further reducing the rate of employment, hence at  $F_1$  the highest feasible rate of investment

<sup>16</sup> Alternatively, if  $f_L$ —which in a competitive free labor market also represents the real wage—exceeds  $w^*$ , then the institutional wage is a ceiling and not a floor; therefore, there can be no surplus labor problem. Of course, if the rate of growth of the capital stock ( $I/K$ ) is less than the rate of growth of the labor force, in the long run the economy may slide into a state of surplus labor. This will be discussed later.

<sup>17</sup> In fact, the elimination of the next unit of labor would already raise  $f_L$  above  $w^*$  resulting in a reduction of both outputs, i.e., in a feasibility function which bends backward from  $B_1$  to the origin. This can clearly be ruled out as inefficient under any welfare system.

<sup>18</sup> This assumes that the production functions permit smoothly continuous factor substitution. With fixed coefficients the argument must be restated as in the linear programming example below. In either case, underlying the process is the increase of the aggregate (national) capital employment ratio.

is attained.<sup>19</sup> Simultaneously consumption—which because of (3) constrains the rate of employment all along  $B_1F_1$ —reaches its minimum, i.e., just that level needed to maintain the maximum feasible rate of investment consistent with  $w^*$ .

Thus, the  $FFw^*$  consists of two segments: the arc  $AB_1$  which coincides with the STF and the arc  $B_1F_1$  which falls below it. It is evident, however, that had we chosen a nonzero wage rate smaller than  $w^*$ —say  $w^{**}$ —then we could have increased the output of  $I$  along the arc  $AG$  past  $B_1$ . Such a  $FFw^{**}$  is shown by  $AB_2F_2$  in Figure 1. Analogously to the case of  $w^*$ , (3) is not binding along the segment  $AB_2$ , but constrains the rate of employment on the segment  $B_2C_2$  which is below the arc  $AG$ . Thus  $AG$  constitutes a boundary relationship also for this feasibility function, and it would be easy to demonstrate that such must be the case with any and all possible  $FF\bar{w}$ .<sup>20</sup> It is in this sense that  $I=I(C; \bar{w}=0)$  should be thought of as the social transformation function.

### 3. Conditions of the Social Optimum and the Shadow Prices

As in the case of the STF, the optimum combination of outputs is found at the tangency of the price-income line formed from (6) and the  $FF\bar{w}$ . The smaller  $P_I$  is relative to  $P_C$ , the more likely it is that the optimal combination of outputs will lie on that segment which coincides with the STF. Conversely, the greater  $P_I$  is relative to  $P_C$ , the more likely it is that production will take place on the segment which is below the STF. In the limit, when  $P_C$  is zero, i.e., if consumption is not valued per se, production will take place at that point of the  $FF\bar{w}$  which corresponds to the largest attainable rate of investment consistent with  $\bar{w}$ .<sup>21</sup>

In either case, associated with each maximum solution there is a set of shadow prices and the different segments of the  $FF\bar{w}$  can best be characterized in terms of the latter. The prices themselves represent the direct and indirect contributions of the marginal units of each output or service to the value of (6). Formally they are derived from the mathematical conditions of the maximum of (6) subject to the relationship (1) to (5), but they can also be deduced from a general understanding of how this economy must function.<sup>22</sup>

<sup>19</sup> In fact, for the same reasons as under (9b) a further reduction in the rate of employment would result in a backward-bending feasibility relationship.

<sup>20</sup> If  $\bar{w}$  exceeds  $C/L$  at  $I=0$ , then the  $FF\bar{w}$  must lie everywhere below the social transformation function with its vertex lower than  $A$ . In this case (3) is always binding and full employment cannot be attained anywhere on the  $FF\bar{w}$ .

<sup>21</sup>  $P_C=0$  implies that the price-income line formed from (6) is vertical to the  $I$  axis and tangent to  $I=I(C; \bar{w})$  at its maximum.

<sup>22</sup> The relationships (10) to (15) below are actually differential relationships obtained by partially differentiating with respect to the output and input variables the following Lagrange expression:

To this end consider the uses of the two goods which enter the maximand, i.e., relationship (6). Investment is produced for the provision of future consumption, but in a temporal reckoning constitutes nothing but a final good. Hence, the shadow price of  $I$  ( $U_I$ ) is its direct contribution to the value of the maximand, so that we can write

$$(10) \quad U_I = P_I.$$

However, the same cannot be said about consumption, which is produced for two distinct purposes: (a) as a final good for its temporal enjoyment and (b) as an intermediate good or an input to sustain the labor employed in turning out the national product. The first type of use is evident from the fact that consumption is a socially valued activity. The second is evident from (3): labor requires  $C$  in the same way as a tractor needs fuel. Though the two purposes of  $C$  are fulfilled simultaneously,  $P_C$  values only its direct contribution to welfare, as attested by the fact that even if  $P_C$  is zero, i.e., if consumption is not valued per se, the output of  $C$  must still be positive at the level that corresponds to the maximum investment point of the  $FF\bar{w}$ . It follows that there must be a *market price* ( $U_C$ ), i.e., the price needed to bring forth the last unit of  $C$ , which cannot be zero under any circumstances and which must contain both the arbitrarily given *welfare valuation* ( $P_C$ ) and the implicit *input valuation* ( $U_{CW}$ ). Accordingly, the market price can be written as

$$(11) \quad U_C = P_C + U_{CW}.$$

Now the relationships governing the allocation of resources can also be deduced. Denoting the rent of capital by  $U_K$  and its marginal product in the two employments by  $F_K$  and  $f_K$  respectively, capital will be optimally used if

$$(12) \quad U_I F_K = U_K,$$

and

$$(13) \quad U_C f_K = U_K.$$

These are the well-known conditions for the equivalences of the values of the marginal products. An analogous set must be available also for the employment of labor. The social cost of labor is determined, how-

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$$P_C C + P_I I - U_I [I - F] - U_C [C - f] - U_{CW} [\bar{w} L_I + \bar{w} L_C - C] \\ - U_K [K_I + K_C - K(\bar{t})] - U_W [L_I + L_C - L(\bar{t})].$$

The Lagrange variables which can be interpreted as shadow prices are denoted by the  $U$ -s where the subscripts identify the constraints they are associated with. Although the differential relationships should properly be written in the form of inequalities, I have not done so because, excepting the case where  $P_I = 0$ , they are always binding.

ever, not only by its relative scarcity but also by the constraint on its use due to the consumption requirement. Correspondingly, the shadow wage rate ( $U_L$ ) itself must have two component elements: a competitive wage rate ( $U_W$ ) determined by labor's relative scarcity, and the consumption requirement priced in terms of the input valuation of  $C$ . Accordingly, the marginal equivalences regulating labor's employment can be written as

$$(14) \quad U_{IFL} = U_L = U_W + U_{CW}\bar{w},$$

and

$$(15) \quad U_{cFL} = U_L = U_W + U_{CW}\bar{w}.$$

These relationships reduce to simpler forms if the segment of the  $FF\bar{w}$  where the optimal production is to take place can be identified. Specifically, we know that on the segment which coincides with the STF the consumption constraint (3) is not binding, because more  $C$  is produced for final use than is needed to maintain the labor force. Then, because  $C$  *qua* input is not scarce, its input valuation ( $U_{CW}$ ) is zero so that  $U_C = P_C$  and  $U_L = U_W$ . Now (14) and (15) can be written as

$$(16) \quad P_{cFL} = U_W = P_{IFL}.$$

Notice that this relationship is identical to (8), i.e., to the condition which governs the optimal allocation of labor when  $\bar{w}$  is zero. From this follows the first allocation rule in the surplus labor economy which is that: if the supply of consumer goods does not constrain the rate of employment, labor should be allocated as if the wage rate were determined in a purely competitive free labor market and not institutionally fixed.

On the other hand, when the  $FF\bar{w}$  is below the STF, consumption does constrain the rate of employment so that the institutional wage consumption is directly relevant to social allocation decisions. Then, because  $C$  as an input is scarce,  $U_{CW}$  is positive and, because labor is not fully employed,  $U_W$  is zero. It follows that  $U_L = U_{CW}\bar{w}$ , so that (14) and (15) can be written as

$$(17) \quad U_{IFL} = U_{CW}\bar{w},$$

and

$$(18) \quad U_{cFL} = U_{CW}\bar{w};$$

or, by substituting (11),

$$(19) \quad U_{IFL} = (U_C - P_C)\bar{w},$$

and

$$(20) \quad U_{cf_L} = (U_C - P_C)\bar{w}.$$

Now, as the second allocation rule in the labor surplus economy we can state that: if the supply of consumer goods does constrain the rate of employment, labor should be allocated so as to equate the *market value* of its marginal product in each sector to the *input value* of the institutional wage rate. In other words, if the marginal products are valued in terms of the market prices, the institutional wage rate—because it represents not only the real wage cost but also the consumption of the marginal unit of labor—must be valued in terms of a price which is less than the market price by the value of the weight society places on consumption per se.

The above condition also reveals that if a continuous adjustment of factor proportions is possible and *if consumption is valued per se, the maximum investment point on the  $FF\bar{w}$  cannot be socially optimal*. This is evident from (20) which indicates that, if  $P_C > 0$ , then in equilibrium  $\bar{w} > f_L$ .<sup>23</sup> But we know from the discussion of (9c) that the point of maximum investment is attained only when  $\bar{w} = f_L$ , and that if  $\bar{w} > f_L$ , the rate of investment cannot be at its maximum.<sup>24</sup>

It follows as a corollary that *if consumption is valued per se, a competitive free market system cannot attain the social optimum* in this labor surplus economy.<sup>25</sup> This is so because the free market solution must necessarily coincide with that point of the  $FF\bar{w}$  where the fundamental condition of private profit maximization, i.e., the equating of the marginal product to the real wage rate, is satisfied. The employer must pay the market value of  $\bar{w}$  as the money wage rate so that the *free market*

\* <sup>23</sup> (20) can be restated in the form  $f_L/\bar{w} = (U_C - P_C)/U_C$ , to show that in equilibrium the ratio of  $f_L$  to  $\bar{w}$  must be identical to the percentage difference between the market and the welfare price. Only if the latter is zero can the two be identical.

<sup>24</sup> This can also be shown if, by eliminating the shadow prices from relationships (10) to (15), the marginal conditions are restated in terms of the ratios of marginal productivities. Notice that on that segment of the  $FF\bar{w}$  which is below the STF the market price of  $C$  differs from its welfare price. Hence, on that segment there must be two sets of tangency conditions: one in the output and one in the utility space. The condition in the output space is given by

$$f_L/f_L = U_I/U_C = f_K/f_K,$$

and in the utility space by

$$P_I/P_C = (f_L/f_L)\bar{w}/(\bar{w} - f_L).$$

In the latter the ratio of the marginal products is weighted by the percentage gap between  $\bar{w}$  and  $f_L$ . When  $P_C > 0$ , then  $\bar{w} > f_L$  and the ratio is positive, so that the slope of the  $FF\bar{w}$  at the tangency is negative. When  $P_C = 0$ , then  $\bar{w} = f_L$  and the gap vanishes. When  $f_L > \bar{w}$ , the expression is negative signifying a "hyper-negative" marginal rate of transformation, i.e., a backward bending segment on the  $FF\bar{w}$ . The implication is that the maximum of  $I = I(C; \bar{w})$  is at  $P_C = 0$ . (Note that with constant returns to scale the convexity of the feasible region is assured so that there is no need to consider the second order condition.)

<sup>25</sup> Exception must be made for the knife edge case (9b).

condition of profit maximization would be

$$(21) \quad U_I F_L = U_C \bar{w} = U_C f_L.$$

The social conditions of optimal allocation reduce from (19) and (20) to (21) and  $f_L$  becomes equal to  $\bar{w}$  only when  $P_C$  is zero which is at the maximum investment point. Hence, *the maximum investment point represents the free market solution* in the labor surplus economy.

#### 4. The Identification of the Welfare Weights

The derivation of the shadow prices hinges, of course, on the knowledge of the welfare weights  $P_I$  and  $P_C$ . If the welfare function is known, the ratio of the two, i.e., the relative weights, can be identified as the slope of the  $FF\bar{w}$  or the welfare function at the point of tangency. In that case, the shadow prices represent the increments in utility with respect to particular activities. Welfare functions, however, may be too general to be directly applicable to this approach to quantitative planning: their arguments are the temporal level and the rate of growth of  $C$  and their values are not cardinally measurable in terms of income. Instead, to fit the conditions of this analysis, I shall adopt a simpler relationship—to be referred to as the objective function—which has current consumption and investment as its arguments and a scale which is so chosen as to permit the cardinal measurement of social welfare in terms of income.<sup>26</sup>

The specific form of the objective function is given by

$$(22) \quad U = I^p C^{1-p}; \quad 0 \leq p \leq 1.$$

The exponent  $p$  is a parameter representing the proportion of investment and  $(1-p)$  the proportion of consumption in the national product valued at welfare prices. In other words  $p$  is the social average propensity to save and  $(1-p)$  the social average propensity to consume out of income valued at welfare prices. The choice of a particular  $p$  represents a fundamental social decision about the desired balance between current and future welfare.

If (22) replaces (6) as the maximand then  $P_I$  and  $P_C$  are themselves determined as shadow prices in a process of optimization. Their values are then given by

$$(23) \quad P_I = pU/I, \quad \text{and} \quad P_C = (1-p)U/C.^{27}$$

But because the scale of  $U$  is so chosen as to be cardinally measurable in terms of income, we can write

$$(24) \quad P_I = pY/I, \quad \text{and} \quad P_C = (1-p)Y/C,$$

<sup>26</sup> For this purpose the function must be first order homogeneous.

<sup>27</sup> These can be directly obtained by partially differentiating (22) with respect to  $I$  and  $C$ .

where  $Y$  is the equilibrium level of income valued at welfare prices and  $C$  and  $I$  are the equilibrium rates of output.

With the introduction of the objective function the two arbitrary welfare weights are replaced by a single policy parameter which has intuitive meaning for the planner.<sup>28</sup> The larger  $p$  is, the greater is the weight on investment and growth relative to consumption per se. In the limit, as is evident from (24), the welfare valuation of  $C$  is zero.<sup>29</sup>

### 5. Policies for Attaining the Social Optimum

The discussion in 3, above, suggests that, if production takes place at any but the maximum investment point on the  $FF\bar{w}$ , in the absence of government intervention the market mechanism returns the economy to the free market solution. In fact, as long as the marginal cost of labor exceeds the marginal revenue due to the last unit of labor, the natural response of profit maximizing employers in stable markets is to keep lowering the rate of employment. By this method the marginal product is raised to the point where it equals the wage rate and the conditions of profit maximization are satisfied. In the process, the free market forces lead to the largest attainable rate of investment at the expense of employment and redistributed consumption.

But what if the free market solution is inconsistent with social preferences, which must be the case if consumption is valued per se? Then the market forces must be offset either by imposing direct controls on resource allocation or by amending the price system so as to encourage individual entrepreneurs to use resources in the socially optimal pattern.

The comparison of (19) and (20) with (21) reveals that there is a difference between the private and public cost of (or benefit from) the last unit of employed labor. The private benefit is the market value of the marginal product in each sector and the private cost is the market value of  $\bar{w}$  to be paid as the money wage rate by the employer. What is registered in (19)–(20) but not considered by the private employer is that the wage payment turns directly into consumption—a socially valued activity—which directly augments the welfare value of the national product by the amount  $P_C\bar{w}$ . This is a nonmarket benefit which, if the socially optimal rate of employment is to be attained by decentralized means, must either be added to the marginal market returns imputable to labor or subtracted from its cost.

It is evident that a payroll subsidy of  $P_C\bar{w}$  per unit of labor is just

<sup>28</sup> As added advantage, if the preparation of the plan requires the application of linear programming, the fixed coefficient approximation of (22)—as will be seen in Part II—permits the derivation of single valued solutions which a linear maximand such as (6) would be incapable of generating at other than vertex points.

<sup>29</sup> When  $p=0$  or 1, (22) represents linear maximands which are horizontal or vertical to the  $I$  axis, respectively. When  $0 < p < 1$ , the function is a rectangular hyperbola

right for the purpose. But what should be the source of the funds for such a subsidy? Inspection of the functional distribution of income among the productive factors, i.e., the factor shares imputed to scarce resources, provides the answer. It will be different, of course, on the two segments of the  $FF\bar{w}$ .

When consumption constrains the rate of employment, i.e., on that segment of the  $FF\bar{w}$  which is below the STF, labor is underemployed, so that capital is the only scarce resource. Hence, the entire welfare value of the national product must be imputed to capital as rental income and we can write

$$(25) \quad U_K K(t) = P_I I + P_C C.$$

At the free market point, when  $P_C = 0$ , the welfare value of the national product consists of the value of investment. In that case no payroll subsidy is required, because the entire market value of the  $C$  output is paid out to labor in the form of wages. On the other hand, when  $P_C$  is greater than zero, there is a gap of  $P_C \bar{w}$  between the money wage rate and the social cost of labor, requiring a total payroll subsidy of  $P_C \bar{w} E$  or, because of (3),  $P_C C$ . If this amount is taxed away from the rental income of capital and returned to the employers in the form of the subsidy, total rents after taxation amount to

$$(26) \quad rK(t) = P_I I,$$

where  $r$  is the rate of return to capital *after* profit taxation.

The gap between the private and social cost of labor, which was shown to correspond to the welfare valuation of  $\bar{w}$ , can also be expressed in terms of the market price of  $C$ . From (20) the subsidy required per unit of employed labor ( $S_B$ ) amounts to

$$(27) \quad S_B = U_C(\bar{w} - f_L) = P_C \bar{w}.$$

It goes without saying that the higher the desired level of employment the greater the labor intensity of production (or the lower labor's marginal productivity) must be, and hence, the larger the payroll subsidy must be relative to the value of labor's marginal product. In the limit, if labor were redundant even on the STF, all wages would have to come from subsidies.

When consumption does not constrain the rate of employment, i.e., when (3) is not binding, the  $FF\bar{w}$  coincides with the STF. Then, if labor is scarce, part of the total income must be imputed also to labor. The share corresponds to what in the absence of an institutional remuneration labor's competitive free market wage income would be, i.e.,  $U_W L$  or  $P_C f_L L$ .<sup>30</sup> Then the imputed rental income of capital can be written as

<sup>30</sup> See relationship (16).



$$(28) \quad U_K K(t) = P_I I + P_C C - U_W L = P_I I + P_C (C - f_L L).$$

The need for a payroll subsidy exists also on this segment of the  $FF\bar{w}$ . The expression under (27) is valid but, because  $FF\bar{w}$  coincides with the STF, the market price ( $U_C$ ) is identical with  $P_C$ , so that the subsidy per unit of labor can be written as

$$(29) \quad S_L = P_C (\bar{w} - f_L).$$

In addition, we must remember that on this segment of the  $FF\bar{w}$  (3) is not binding, i.e., the  $C$  output exceeds the wage demand. The value of this surplus is already included in the share of capital under (28) but its market must still be identified. Since consumption from rents is by assumption zero, it is up to the government to purchase the surplus at the price  $P_C$  for redistribution, storage, or for some other purpose. This indicates the need for further profit taxation in the amount of

$$(30) \quad T_C = P_C (C - \bar{w} L).$$

The rental income after taxes is obtained by subtracting the payroll subsidy and the tax for the purchase of the surplus goods from (28). If  $r$  again stands for the profit rate after taxes,

$$(31) \quad rK(t) = U_K K(t) - LS_E - T_C = P_I I.$$

Note that whether the purpose of taxation is to finance simply a payroll subsidy or to purchase the surplus of consumer goods as well, the resulting rental income after taxes—as shown by (26) and (31)—coincides with the value of total investment. Recall now the objective function (22) whose exponent  $p$  was defined as the social average propensity to save out of the national product at welfare prices.<sup>21</sup> Since the two weights  $P_I$  and  $P_C$  could be expressed in terms of this single parameter, based on (24) we now can write

$$(32) \quad pY = P_I I$$

and by substituting either (26) or (31)

$$(33) \quad pY = rK(t).$$

In other words, rental income after taxes must equal the desired social rate of savings. When surplus labor exists (i.e., when (5) is nonbinding

<sup>21</sup> Remember, though, that the income concept from which the social savings rate is obtained is based on welfare prices and not on market prices customarily used in national income accounts. Whereas the welfare price and market price of  $I$  are identical, this is not always the case with the consumer good as indicated by the discussion preceding (11). National income accounting would use the market prices  $U_I$  and  $U_C$  to value the products and to account wages and profits as  $U_C \bar{w} L$  and  $Y - U_C \bar{w} L$ , respectively. These, being *ex post* magnitudes representing the market outcome after the application of the tax-subsidy scheme, could coincide with welfare values only if  $U_C = P_C$ , i.e., on the STF itself.

so that  $U_w = 0$  either because the  $FF\bar{w}$  is below the STF, or because there is an incipient redundancy of labor on the STF) we can further write

$$(34) \quad pY = pU_K K(t) = rK(t),$$

from which

$$(35) \quad r = pU_K.$$

It follows that the rate of return tax must be  $(1-p)$ . In the free market solution, when  $p$  is equal to one (i.e., when the social valuation of consumption is zero), then the tax rate is zero, and  $r$  is identically equal to  $U_K$ .

### 6. Growth and Welfare Optima

The planning problem cannot be solved, of course, without considering the time path of consumption and employment. In the temporal solution, to each welfare optimum on the  $FF\bar{w}$  a unique level of  $I$  corresponds. If  $I$  is homogeneous and the capital stock is optimally divided between the two sectors, then  $I/K(t)$  represents the instantaneous rate of growth of the capital stock. The higher the rate of investment relative to the stock of capital the higher will be the rate of capital accumulation. However, the effect of the latter on the rates of growth of other activities cannot be deduced without knowing the exact conditions prevailing elsewhere in the economy.

As long as surplus labor exists (i.e., when (5) is nonbinding) capital is the only scarce input. In that case, with constant returns to scale in all activities, it is evident that the outputs of  $I$ ,  $C$ , income, and employment must grow at the same constant rate as the capital stock.<sup>32</sup> Let us denote this balanced growth rate by  $g_{pw}$  where the subscripts represent the particular social savings rate and the real wage rate. Then we can write

$$(36) \quad g_{pw} = I/K(t).^{33}$$

However, the real rate of return to capital after taxes is defined by

$$(37) \quad q = r/P_I,$$

and from (32)–(33) we know that

$$(38) \quad P_I I = rK(t).$$

<sup>32</sup> If initially the capital stock is not optimally divided among the sectors, i.e., if the system starts out from arbitrary initial conditions, then the path will asymptotically approach the balanced growth path as long as capital is the only scarce input. This requires, however, that the production functions have the additional property  $g(0)=0$ ,  $\lim_{k \rightarrow 0} g'(k) = \infty$  and  $\lim_{k \rightarrow \infty} g'(k) = 0$ , where  $k$  is the capital labor ratio.

<sup>33</sup> For the sake of this argument, it is assumed that  $I$  represents net investment.

From this last expression, by substituting for  $r$  in (37), we obtain

$$(39) \quad q = I/K(t) = g_{pw}.$$

In other words the growth rate is identically equal to the real rate of return to capital.<sup>34</sup> The latter will naturally be at its highest when production takes place at the maximum investment point of the  $FF\bar{w}$ , which is another reason why that point must represent the competitive free market solution.

The free market solution is socially optimal only if consumption is not valued per se, i.e., if  $\bar{p}$  equals one. For any  $\bar{p}$  less than one, the rates of current consumption and employment are larger than in the free market solution, but because the corresponding investment is lower, their rates of growth are also lower. Each particular solution requires a different length of time for the elimination of unemployment, so that the choice of  $\bar{p}$  in fact implies a choice among growth paths which have distinct income distributional consequences.

Starting from an initial state of unemployment, the rate of growth associated with the free market point on the  $FF\bar{w}$  defines the time minimizing path to full employment.<sup>35</sup> This is shown in Figure 2 where (in semi-log plotting) the full employment ceiling is represented by the upper line (itself growing at rate  $n$ ) and where the equilibrium time path of employment corresponding to  $\bar{p}=1$  starts out at  $\text{Log } E_1$ . The slope of this line is the maximal rate of growth requiring the greatest initial sacrifice in terms of temporal employment and consumption of which the system is capable given that  $\bar{w}=w^*$ . If consumption is valued per se, i.e., if  $\bar{p}$  is smaller than one, the path starts out with a higher initial rate of employment and consumption, but the rate of growth is lower and hence the time needed to attain full employment is longer. This is illustrated by the path starting at  $\text{Log } E_1$  in Figure 2. The smaller  $\bar{p}$  is, the smaller the equilibrium growth rate. If the latter is less than  $n$ , it is insufficient for reaching full employment. It is possible, of course, that even the maximal growth rate (i.e., at  $\bar{p}=1$ ) could be less than  $n$ . In that case full employment could not be attained without a cut in the wage rate.

The preceding analysis is relevant only if the growth path starts out from an initial state of unemployment. But if full employment is feasible anywhere on the  $FF\bar{w}$ —as we assumed could be the case—the govern-

<sup>34</sup> Given the savings assumptions and a constant marginal utility of income, this rate of return also represents the rate of interest. Furthermore, since  $q$  is the real rate of return after the application of the corrective tax-subsidy scheme, it is also the social rate of interest. However, if consumption by capitalists were represented not as a constant proportion of  $\bar{w}$  but as a function of either the capital stock or the rate of return, the interest rate would exceed the growth rate.

<sup>35</sup> See Lefebvre and Chakravarty [5]. Note that this path conforms to "the golden rule" of capital accumulation. See Phelps [10].

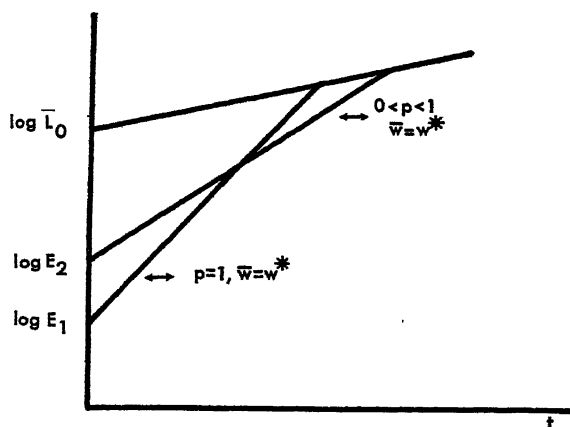


FIGURE 2

ment may want to move immediately to establish full employment with the help of a tax-subsidy program. With such a move the rate of growth of employment would be limited to the growth of the labor force and the resulting growth path would not be balanced.<sup>36</sup> Of course, the government would want to pursue this policy only if full employment could be maintained also in the long run. This requires that as long as  $\bar{w}$  exceeds  $f_L$  the rate of growth of the capital stock ( $I/K$ ) should exceed the rate of growth of the labor force ( $n$ ). If  $I/K$  were less than  $n$  then the rate of growth of the consumer good output would also be less than  $n$  and full employment could be maintained only temporarily. When the full employment demand for  $C$  could no longer be satisfied, the economy would have to revert to a state of unemployment.

### 7. The Effect of Changing the Wage Rate

If the growth rate associated with the free market solution is less than the rate of growth of the labor force, the institutional wage rate is incompatible with employment objectives. Then, only by cutting  $\bar{w}$  from  $w^*$  to some  $w^{**}$  can the minimum consumption requirement of the fully employed labor force be lowered to permit the increase of the rate of investment (growth). The new  $FFw^{**}$  would have the form of  $AB_2F_2$  in Figure 1 if condition (9c) were again satisfied, i.e., if  $f_L < w^{**}$  at the point where (3) becomes binding. One must keep in mind, however, that the case may be different. The marginal products of the inputs do change along the STF; hence, it could happen that a change in the wage rate—depending on the induced changes in the output combination and in the marginal products—might result in the elimination of the gap

<sup>36</sup> Balanced growth in full employment requires both that production should take place at a free market point on the STF (as in case 9b) and that  $I/K$  should be the same as  $n$ .

between  $\bar{w}$  and  $f_L$  in full employment. If this were the case, the change in the wage rate would also eliminate the state of surplus labor. Furthermore, depending on the relative factor intensities in the two industries, this same result may be possible in response to either a *decrease* or an *increase* in the institutional wage rate.<sup>37</sup>

This is an important result. It implies that if there is no incipient redundancy of labor, a state of surplus labor cannot be unambiguously identified without reference to a specific wage rate.<sup>38</sup> But more significant than that is the further implication that the employment effects of wage changes cannot be determined in the surplus labor economy without taking into account also the prevailing sectoral factor intensities. Specifically, even though a wage cut accompanied by a tax-subsidy scheme can always result in a higher rate of total employment, the same cannot be said with certainty about the free market consequences of a wage cut. This is quite evident in the case of fixed coefficient technologies where the direction of the change in the rate of employment is determined by factor proportions alone. For instance, in the numerical analysis of Part II, the rate of employment in the free market solution—contrary to traditional expectation—always decreases in response to a wage cut because the direct and indirect labor requirements of investment are lower than in consumer good production. Depending on the circumstances, such results may also be possible with variable proportions. However, because factor substitution in response to a wage cut may or may not offset the influence of relative factor intensities on the demand for labor, for an a priori judgment on the employment effects of a change in the wage rate one needs more specific knowledge about the structure of production.

Finally, it is interesting to note that when incipient redundancy prevails—as it does in the numerical analysis—if we choose to hold constant the growth rate instead of  $\bar{w}$ , the maximal growth path cor-

<sup>37</sup> Consider the case where the  $C$  sector is labor intensive relative to the  $I$  sector. Then, as is well known from trade theory,  $f_L$  must increase as the output of  $C$  is diminished along the STF. If  $\bar{w}$  is cut from  $w^*$  to  $w^{**}$ , the  $C$  output can be lowered along the STF from its previous limiting level at  $B_1$  to the new point where (3) again turns binding. If  $f_L$  rises above  $w^{**}$  before this point is reached, the conditions discussed in connection with (9c) cease to exist; instead, the case of (9a) becomes relevant. In other words, relative to the new institutional wage rate, there is no state of surplus labor.

Consider now the converse case where the  $C$  sector is relatively capital intensive. If then the output of  $C$  increases along the STF, so does  $f_L$ . An increase in  $\bar{w}$  calls for an increase in the full employment demand for  $C$ . If in the process  $f_L$  rises above the new  $\bar{w}$  so that (9c) ceases to hold, the state of surplus labor is eliminated. In this case, however, the capacity to invest is diminished and if in the process  $I/K$  were to fall below  $n$ , in time the economy would have to revert to a state of surplus labor.

<sup>38</sup> To avoid the definitional ambiguity, T. N. Srinivasan has suggested in private correspondence that, in the absence of incipient redundancy, a surplus labor economy should be characterized as one in which (a) the savings assumptions of this analysis hold and (b) the  $C$  sector is more capital intensive than the  $I$  sector and hence there is redundancy of labor at any specific  $\bar{w} \geq$  some minimum value.

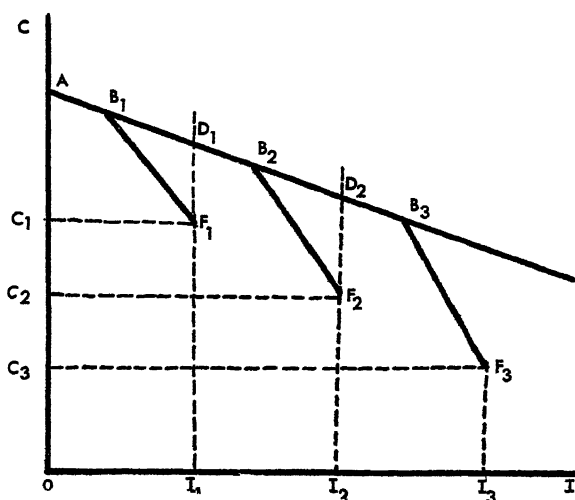


FIGURE 3

responding to  $p=1$  is not the fastest to full employment. For instance, assume that investment is maintained at the rate  $I_1$  in Figure 3. Then with a suitable cut in the wage rate and a corresponding tax-subsidy policy we can move from  $F_1$  to  $D_1$  on the STF. The rate of growth remains unchanged at  $I_1/K(\dot{i})$ . At the same time, employment at  $D_1$  is larger than at  $F_1$ . Hence, for a given growth rate, the government-sustained path associated with  $D_1$  will not only lead to full employment faster than the free market path but in addition will provide a higher current rate of consumption.

## II. Numerical Analysis

The preceding analysis can readily be incorporated into a computable planning model. For purposes of demonstration I adopt a simplified linear programming framework which in addition to consumption and investment also accounts for intermediate output flows and foreign trade. The computations make use of data relating to the Indian economy in 1960 but it should be quite clear that the intention is to illustrate and not to draw authoritative conclusions about development strategy in India.

### 1. The Structure of the Planning Model

As a fixed coefficient approximation of the previous objective function we assume that

$$(40) \quad Y = \min [I/p, C/(1-p)], \quad 0 \leq p \leq 1;$$

where  $p$  corresponds to the parameter of (22). In the linear programming

model we maximize income,  $Y$ , subject to the constraints summarized in Table 1 which include (40).<sup>39</sup> As before, in the solution all variables must be non-negative.

There are three outputs  $X_1$ ,  $X_2$ , and  $X_3$ , representing the capital goods, the consumer goods, and "universal intermediary"<sup>40</sup> sectors, respectively. The first two sectors each produce a final domestic output,  $I$  and  $C$ , as well as exports ( $E_1$ ,  $E_2$ ) and intermediate outputs for exclusive use within the sector of origin ( $X_{11}$ ,  $X_{22}$ ). The third sector produces only intermediate goods which are for use in all three sectors ( $X_{3j}$ ). In addition, each sector requires imports ( $M_i$ ), labor ( $L_i$ ) and capital ( $K_i$ ). The flow, import, labor and capital coefficients are denoted by  $a_{ij}$ ,  $m_i$ ,  $l_i$  and  $b_i$ , respectively.

The block triangular structure of production is readily depicted in Table 2 which is self-explanatory.<sup>41</sup> Clarification is required only on two points. First, Table 2 does not indicate the wage demand for consumer goods which is expressed by the next to the last direct constraint in Table 1. Second, according to the balance of payments constraint, total imports ( $M$ ) must equal a constant ( $e$ ) times total exports ( $E$ ).<sup>42</sup> The

<sup>39</sup> The constraints of the maximum problem can be obtained from Table 1 by the "direct" reading of the programming matrix. Specifically the central matrix ( $25 \times 25$ ) of the coefficients is to be post-multiplied with the column vector ( $25 \times 1$ ) of choice variables, written for convenience as a row vector and located at the top of the center matrix. The constants of the constraints are given in the column vector ( $25 \times 1$ ) on the right-hand side of the central matrix. This has only one non-zero term,  $K(i)$ .

The associate "dual" problem of cost minimization has  $U_K K(i)$  as its minimand (where  $U_K$  is the rate of return on capital). The constraints are obtained by the dual reading of the matrix. The column at the left-hand side is the vector of dual (price) variables. By successively multiplying vectorially the column of dual variables with each column of the central matrix, we obtain the homogeneous part of each dual constraint. The constants are given by a column vector ( $25 \times 1$ ) which is for convenience written as a row vector below the central matrix. Here, the only non-zero term is the price of  $Y$ , which is arbitrarily chosen as one.

<sup>40</sup> Alan Manne's terminology. In fact, the structure of production follows his concept of block-triangularity. See [7].

<sup>41</sup> The values of the parameters are based on the structure of the Indian economy in 1960, as described in the two sources [7] and [9]. However, the information was not always available in that form which meets the specifications of this model and in the process of adaptation much accuracy may have been lost, for which the authors of the cited references cannot be held responsible.

<sup>42</sup> Note that this specification maintains the homogeneity of the constraint and hence is consistent with balanced growth. The same is the case with the capital constraints which permit the optimal distribution of the initial capital stock. The system could, of course, be specified to start from arbitrary initial conditions; however, the gain from a possibly better approximation of the true initial conditions may be more than offset by the arbitrariness of the consequent sectoral capacity adjustments. Because of the rigidity due to the fixed coefficients, the maximizing mechanism balances the sectoral outputs by introducing excess capacities which may be very large in the initial periods even if the system converges rapidly to the balanced path. The adjustment process in [2] and [4] illustrates the point. In addition, direct statistical information on initial capacities does not exist and the error of the estimates based on observed initial outputs is difficult to assess. In fact, it is conceivable that the capacities determined by the optimal distribution of the initial capital stock provide a better approximation.





TABLE 2

	1	2	3	<i>E</i>	<i>I</i> <i>C</i>	<i>X</i>
1	$a_{11} = .320$			$E_1$	<i>I</i>	$X_1$
2		$a_{22} = .210$		$E_2$		$X_2$
3	$a_{31} = .074$	$a_{32} = .031$	$a_{33} = .520$		<i>C</i>	$X_3$
<i>M</i>	$m_1 = .126$	$m_2 = .026$	$m_3 = .160$	$M = 1.7E$		
<i>L</i>	$l_1 = .0005$	$l_2 = .0009$	$l_3 = .0005$	$\bar{w} = 700 \text{ Rs}$		
<i>K</i>	$b_1 = 2.000$	$b_2 = 2.500$	$b_3 = 6.000$	$\bar{K} = 565.6 \times 10^9 \text{ Rs}$		

multiplier  $e$  represents the proportion of total imports to total exports, in other words, the balance of payments deficit is a constant proportion of total exports (or imports). The gap can be viewed as a foreign aid requirement tied to export performance. Alternatively,  $e$  can be interpreted as a measure of the systematic overvaluation of the domestic currency requiring balance of payments support.

## 2. The Shadow Prices

The dual variables of the cost-minimizing problem are listed in the lefthand column vector of Table 1. These are shadow prices of goods and services as identified by their subscripts.<sup>43</sup> Though this is evident from the dual reading of Table 1, we can nonetheless note that

$$(41) \quad pP_I + (1 - p)P_C = 1;$$

and hence, because  $Y$  is composed of  $I$  and  $C$  in the constant proportions  $p$  and  $(1 - p)$ ,

$$(42) \quad P_I I + P_C C = Y.^{44}$$

Exports can be supplied from either the capital goods or the consumer goods sector and the export price will be that of the supplying sector. Hence, if both sectors are engaged in exporting, the output prices in the two sectors must be identical. The price of imports is necessarily

$$(43) \quad U_M = eU_B,$$

where  $e$  defines the proportionate balance  $M/X$ .<sup>45</sup>

<sup>43</sup> The shadow prices identified in the preceding analysis are present in the same notation excepting the market price of the output of the consumer good sector which is now identified by  $U_X$  (as opposed to  $U_C$  in the preceding analysis). The shadow prices of exports and imports are given by  $U_B$  and  $U_M$ , and that of foreign exchange by  $U_{FB}$ .

<sup>44</sup> At the maximum investment point  $C$  as input into  $Y$  is redundant but then  $P_C$  is zero.

<sup>45</sup> In Table 1 the shadow price of foreign exchange is identified with the shadow price of imports; however, this is arbitrary. As long as the gap represented by  $e$  is present, the economy must operate with two exchange rates (just as a multiple rate system), i.e.,  $U_B$  and  $U_M$ . When  $e = 1$ , the shadow rate of foreign exchange is unique.

Finally, the shadow wage rate is  $U_{cw}\bar{w}$ . Labor has no scarcity value, hence on the STF, when  $U_{cw}$  is zero, the shadow wage rate is also zero.

Since shadow prices measure the increment in benefits in response to an increment in a given activity we can write that

$$(44) \quad P_I = \Delta Y / \Delta I, \quad \text{and} \quad P_C = \Delta Y / \Delta C.$$

It follows that

$$(45) \quad P_I / P_C = \Delta C / \Delta I.$$

This is the fixed coefficient counterpart of the relationships in footnote 24. Since the feasible region of a linear program consists of a convex polyhedron, (45) identifies the absolute value of the slope of the linear segment on which the equilibrium combination of outputs is located.

### 3. Derivation of the Social Transformation Function

The STF is derived by setting  $\bar{w}$  equal to zero in the program of Table 1. The solutions corresponding to any  $p$  must lie on a single straight line relationship between  $C$  and  $I$ . This is so because capital is the only binding constraint and, given unique fixed coefficient production functions, there is no room for technological choice. The only decision open to choice is in the trade sector: should the capital good or the consumer good industry supply exports? Since capital is the only scarce resource, it is evident that the supplier of exports must be the industry which has the lowest total capital requirements per unit of output. This happens to be the second (consumer good) industry.<sup>46</sup>

Solving for the optimal combination of outputs for any arbitrarily chosen  $p$  between zero and one yields the associated shadow prices of  $I$  and  $C$ . Their ratio, as indicated by (45), defines the slope of the STF. Next by solving for the maximum  $C$  at  $I=0$ , i.e., by maximizing  $Y$  with  $p=0$ , the vertical intercept on the  $C$  axis is obtained. Denoting the latter by  $A$ , the equation of the STF can be written as

$$(46) \quad C = A - (P_I / P_C)I.$$

Given the data of Table 2, the numerical relationship is as follows:

$$(47) \quad C = 150.56 \times 10^3 - 1.2753I.$$

<sup>46</sup> Note that the value of  $b_1$  is smaller than  $b_2$ . But these are only direct or partial capital coefficients. If the flow requirements from the third sector and the import coefficients are accounted for, it is readily seen that the total (direct and indirect) capital coefficient in the first industry is higher than in the second.

Since the total capital requirements of both outputs remain constant on the STF, it has the form

$$C = K(d)/d_2 - (d_1/d_2)I,$$

where  $d_1$  and  $d_2$  represent the total capital coefficients of the first and second sector with the values of about 4.80 and 3.75, respectively. If the source of exports were to be shifted from the second to the first industry, these values would correspondingly increase.

TABLE 3

$w=700$	$A$	$B_2$			$F_2^a$	$D_2^f$
$p$	0	0.176	0.177	0.185	0.186 to 1.000	0.182697
$Y^a$	150.56	143.60	143.43	141.37	141.28 <sup>a</sup>	143.35
$I^a$		25.27	25.39	26.15	26.19	26.19
$C^a$	150.56	118.33	118.04	115.22	115.09	117.16
$E^a$	4.19	6.68	6.74	7.47	7.51	6.77
$E_1^a$			0.50	7.20	7.51	
$E_2^a$	4.19	6.68	6.24	0.27		6.77
$M^a$	7.12	11.35	11.45	12.70	12.76	11.50
$L^b$	182.62	168.96	168.63	164.60	164.42	168.47
$P_I$	0.00	1.2164	2.4957	2.4599	1.00	1.2143
$P_C$	1.00	0.9538	0.6783	0.6686	0.00	0.9521
$U_{X_2}$	1.00	0.9538	2.4957	2.4599	1.1287	0.9521
$U_{CW}$	0.00	0.00	1.8174	1.7914	1.1287	0.0000
$U_L$	0.00	0.00	1272.17	1253.94	790.07	0.0000
$U_K$	0.2662	0.2539	0.2536	0.2500	0.0463	0.2534
$U_E$	1.00	0.9538	2.4957	2.4599	1.00	0.9521
$U_M$	0.5882	0.5610	1.4681	1.4470	0.5882	0.5600
$P_I/P_C$		1.2753	3.6792	3.6792		1.2753
$g^d(pU_K)$	0.0000	0.0447	0.0449	0.0463	0.0463	0.0463

<sup>a</sup> Rs 10<sup>3</sup>.

<sup>b</sup>  $\times 10^6$ .

<sup>c</sup>  $Y$  corresponding to  $p \geq 0.186$  represents the sum of  $C$  and  $I$  but *not* the value of the objective function.

<sup>d</sup> Gross of depreciation and net of technological change.

<sup>e</sup> The price column corresponds to the solution with  $p=1$ . The shadow prices for any  $p \geq 0.186$  are obtained by multiplying each member of this column by  $1/p$ .

<sup>f</sup>  $m \leq 695.5$ .

In other words, the social marginal rate of transformation is 1.2753 constant rupee units of consumer goods for each constant rupee unit of investment.

#### 4. Derivation of the Feasibility Function

Feasibility functions were derived for  $w = \text{Rs } 700$  (the average consumption per unit of active labor in India in 1960) and, for comparison, also for a 10 per cent variation around it, i.e., Rs 770 and 630. The results are summarized in Tables 3, 4 and 5 as well as schematically shown in Figure 3. Since the three functions are similar, it is sufficient to discuss only the case of  $w = 700$ , the details of which are given in Table 3 under the columns denoted by  $A$ ,  $B_2$  and  $F_2$  corresponding to the vertex points of the diagram in Figure 3.

The  $FF_w$  consists of two linear segments:  $AB_2$ , for all values of  $p \leq 0.176$ ; coincides with (47).  $B_2F_2$ , for all  $p \geq 0.177$ , lies below the latter with a steeper slope. The first column under  $B_2$ , Table 3, corresponds to  $p = 0.176$  and describes a solution which is still on  $AB_2$ ;

TABLE 4

$\bar{w}=770$	$A$	$B_1$		$F_1$	$D_1^a$
$p$	0	0.078	0.079	0.087 to 1.00	0.08534
$Y^a$	150.56	147.39	147.25	145.44 <sup>c</sup>	147.10
$I^a$		11.50	11.63	12.55	12.55
$C^a$	150.56	135.89	135.62	132.89	134.55
$L^b$	182.62	176.49	176.13	172.59	175.83
$P_I/P_C$		1.2753	2.9586		1.2753
$g^d (pU_K)$	0.0000	0.0203	0.0206	0.0222	0.0222

<sup>a</sup> Rs 10<sup>3</sup>.<sup>b</sup>  $\times 10^6$ .<sup>c</sup>  $Y$  corresponding to  $p \geq .087$  represent the sum of  $C$  and  $I$  but *not* the value of the objective function.<sup>d</sup> Gross of depreciation and net of technological change.<sup>e</sup>  $\bar{w} \leq 765.2$ .

TABLE 5

$\bar{w}=630$	$A$	$B_1$		$F_1$
$p$	0	0.271	0.272	0.281 to 1.000
$Y^a$	150.56	140.10	139.84	137.49 <sup>c</sup>
$I^a$		37.97	38.03	38.59
$C^a$	150.56	102.13	101.81	98.90
$L^b$	182.62	162.11	161.60	156.98
$P_I/P_C$		1.2753	5.2388	
$g^d (pU_K)$	0.0000	0.0671	0.0672	0.0682

<sup>a</sup> Rs 10<sup>3</sup>.<sup>b</sup>  $\times 10^6$ .<sup>c</sup>  $Y$  corresponding to  $p \geq .281$ . represent the sum of  $C$  and  $I$  but *not* the value of the objective function.<sup>d</sup> Gross of depreciation and net of technological change.

hence, the slope, as indicated by  $P_I/P_C$ , is 1.2753. The vertex at  $B_2$  is at a  $p$  between .176 and .177. The second column under  $B_2$ , corresponding to  $p=.177$ , describes a solution on the segment below the STF. There the marginal rate of transformation ( $P_I/P_C$ ) is 3.6792, i.e., about three times as great as on  $AB_2$ . The  $FF\bar{w}$  reaches its cutoff point with this same finite slope; the maximum  $I$  is attained at  $F_2$  when  $p>.186$ .<sup>47</sup> Note that this is in marked contrast to the general case of

<sup>47</sup> The first column under  $F_2$  corresponds to  $p=.185$  and provides a solution on  $B_2F_2$  just short of the maximum attainable  $I$ . Once the maximum  $I$  is attained the output figures remain constant for all solutions  $p \geq .186$ . However, the price variables continue to change with  $p$ . The limiting value is given by the price column corresponding to  $p=1$ . The prices corresponding to any  $p \geq .186$  are obtained by multiplying the prices corresponding to  $p=1.0$  by  $1/p$ .

continuously adjustable factor proportions in Part I where the point of maximum investment is optimal only when  $p$  equals one.

Because of the unique set of fixed coefficient technologies, the burden of increasing the aggregate capital-labor ratio on  $B_2F_2$  falls entirely on the composition of exports. On the segment  $AB_2$  exports are supplied from the less capital intensive consumer good sector. But moving from  $B_2$  to  $F_2$ , when the rate of employment is constrained by the final output of  $C$ , the capital-labor ratio is increased through the gradual transfer of the supply of exports from the relatively less to the more capital intensive line of production. At  $F_2$ , when all exports are supplied from the more capital intensive investment good sector, the limit of capital intensification is reached.<sup>48</sup>

As was the case in the preceding general analysis, the point at  $F_2$  represents the free market solution. This is evident from the fact that the net rate of return to capital is at its highest at that point. The row corresponding to  $U_K$  in Table 3 provides the gross rents before the imposition of the taxes discussed in Section 4 of Part I. The returns after taxes are obtained by multiplying  $U_K$  by the corresponding  $p$ .<sup>49</sup> But because of the constant currency units in which outputs and capital stock are defined  $pU_K$  is also the growth rate which can be read off in the last row (under  $g$ ) of Table 3.

### 5. Comparison of Alternative $FF\bar{w}$

The  $FF$  specific to  $w=770$ , and 630 are described with less detail in Tables 4 and 5. The marginal rate of transformation is identical on the segments which coincide with (47) but different on the segments below the STF. Specifically, it is the highest with  $\bar{w}=630$  and the lowest with  $\bar{w}=770$ . This is because  $I$  is relatively capital intensive; the more  $I$  is produced, the higher the total capital labor ratio on the STF itself, and the less the residual potential for further capital intensification.

Growth rates within the range of these experiments are very sensitive to the wage rate. The maximum attainable rates of investment are 8.7, 18.6 and 28.1 per cent of national income and the corresponding maximal growth rates are 2.22, 4.63 and 6.82 per cent respectively.<sup>50</sup> However, the wage elasticity of growth rates decreases with lower wage rates. Thus, a 10 per cent cut in the wage rate from  $\bar{w}=770$  to 700 more

<sup>48</sup> Note that because in this particular model there are no means to increase the capital intensity other than by shifting the supply of exports, the segment  $B_2F_2$  is short and steep. If multiple production technologies were to be introduced, the segment would be longer and less steep.

<sup>49</sup> At  $F_2$  itself no taxation is required even if  $p$  is less than one. This is so because  $P_C$  is zero and the value of labor's marginal product exactly equals the market value of the institutional wage rate.

<sup>50</sup> These are "gross" growth rates in the sense that no adjustment is made for either depreciation or technological change.

than doubles the growth rate but causes it to increase by less than 50 per cent when  $\bar{w}$  is cut from 700 to 630. In either case there is a tremendous leverage which is due to the assumption that the induced increments in rents spill totally into savings and investment.

On the other hand, if the growth rate is held constant, say at the level corresponding to  $F_2$ , employment can be increased from its free enterprise level to the level at  $D_2$  on the STF. This can be accomplished, of course, only at the cost of a wage cut. In this particular case, as can be seen from comparing the values under  $F_2$  and  $D_2$  in Table 3, a minimum wage cut of Rs 4.5 is sufficient to obtain an increase of four million in total employment. In percentage terms this means that a .64 per cent wage cut yields a 2.5 per cent increase in employment.<sup>51</sup>

This highly advantageous wage elasticity of employment is due to a higher  $C$  output coupled with a larger aggregate capital labor ratio on the STF than at the free market points. Whether it can be realized depends on the government's ability to institute a payroll subsidy program as discussed earlier. However, if the subsidy program is not possible, the wage cut may have adverse effects on current employment, as is the case in this example. Comparison of the employment levels at the three free market points, at  $F_1$ ,  $F_2$ , and  $F_3$ , indicates that the induced loss in employment is sizeable.

### III. Conclusion

The first point which emerges from the analysis concerns the social role of profits. If they can be made available for investment, the free market in a labor surplus economy leads to the fastest rate of economic growth consistent with an institutionally given real wage rate. Of all the alternatives, however, this is the route to development requiring the greatest sacrifice of current consumption and employment. Nonetheless, since the rate at which unemployment is absorbed is also the highest, the long-run income distributional consequences of the free market are favorable.

Whether they are socially optimal is another question. The free market solution is compatible only with the most austere concept of social welfare which does not value consumption except in terms of its contribution of growth. If society values redistributed current consumption per se, i.e., if society is willing to sacrifice some growth for a higher rate of current employment and hence consumption by wage earners, purely competitive market processes may not lead to a social optimum without some form of intervention.

Consumption and employment can be raised above their free market

<sup>51</sup> An analogous computation is presented also for the shift from  $F_1$  to  $D_1$  in Table 4. There a .62 per cent wage cut results in a 1.85 per cent increase in employment.

rates if the resulting excess of the real wage rate over labor's marginal product—a state associated with all but the free market solution—can be offset with a payroll subsidy financed from profit taxation. The subsidy induces more labor intensive techniques of production and therefore automatically increases the demand for labor and consumer goods. The optimal subsidy for a unit of employed labor could be determined only from a knowledge of the parameters of a social welfare function. However, since the wage payment turns into consumption—an activity which contributes to welfare exactly to the extent that it is valued *per se*—the optimal subsidy may be approximated by the amount of encouragement the political decision makers desire to give to redistributed consumption. The upper limit is, of course, the entire money wage rate, i.e., the market value of the real wage rate which is specified in terms of the consumer good.

Lowering the institutional wage rate may also result in more labor intensive techniques. Nevertheless, a wage cut by itself will not necessarily lead to higher rates of employment or consumption. If the increments to profits are saved it does motivate a higher rate of investment; however, this is at the cost of a lower rate of current consumption and, depending on the effects of relative sectoral factor intensities, possibly even a lower rate of employment. Only if the wage cut is combined with a payroll subsidy can one be certain that, in addition to investment, consumption and employment will also increase.

Finally, a comment on the relevance of this analysis to planning as practiced in reality. According to the preceding argument, for a welfare optimum, growth may have to be slowed down from its free market rate. In contrast, planners are always intent upon raising rather than lowering the growth rate. Actually, there is no intrinsic contradiction. Planners think in terms of minimum politically feasible employment and consumption targets which one may assume are higher than what would correspond to the free market solution. It is subject to these targets that they then attempt to increase the rate of growth. Hence, the optimal solution of the planning problem formulated in these terms may exactly correspond to some point on the feasibility function specific to the given minimum wage rate. A conflict may arise and actual planning may go wrong, however, when the employment and consumption targets are set higher than the free market rate and yet, with no further intervention, the market is relied upon to determine the choice of techniques. In that case the rate of employment will turn out to be less than optimal and targets for the production of consumer goods may prove not to be feasible. If nonetheless the consumption targets are realized, the actual rate of growth will be less than what could be attained with subsidized payrolls.

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## THE VALUE OF TIME IN BARGAINING NEGOTIATIONS: SOME EXPERIMENTAL EVIDENCE

*By* BRUNO CONTINI\*

The theory of pure bargaining has traditionally been cast in terms of bilateral monopoly. Since the times of Edgeworth it has been known that the outcome of a two-person bargain is substantially unpredictable, except for the fact that it will occur within the so-called "trading area," and that, in order for a solution to have some features of stability, it should be "efficient," i.e., it should be located on a tangency point of the two bargainers' indifference lines (the locus of such points is the so-called contract curve, or set of "Pareto-optimal" contracts).

Edgeworth's model, as well as several of its extensions, are essentially of a static nature except for a recent contribution by J. G. Cross [4]. Time plays no role in spite of the fact that it is precisely the cost of time, both in terms of money and utility, that often motivates the bargaining process.

Cross has suggested that the influence of time upon bargaining may assume different forms. First, it appears in a discounting function if the players discount future benefits (as a reflection of one's impatience). Second, the utility of agreement itself may change with the calendar date (nuclear disarmament is probably more important today with many countries that can potentially produce nuclear weapons than it was fifteen years ago when there were only two such countries). Third, there usually is a fixed cost of bargaining that recurs at each stage of the negotiations. This cost may vary from the simple personal inconvenience of having to spend time in this rather than other occupations, to the immense cost in terms of foregone profit and fixed cost of a temporarily unproductive plant which is borne by a strike-bound firm.

In another paper [2] I have shown that the introduction of time as an explicit variable in the utility function of each bargainer leads to a refinement of the classical conclusions, namely, (1) the outcome of a bargaining process may be "stable" even though it may not be efficient; and (2) the evaluation of time is an important determinant of the so-called bargaining power and the lower the evaluation of time of any

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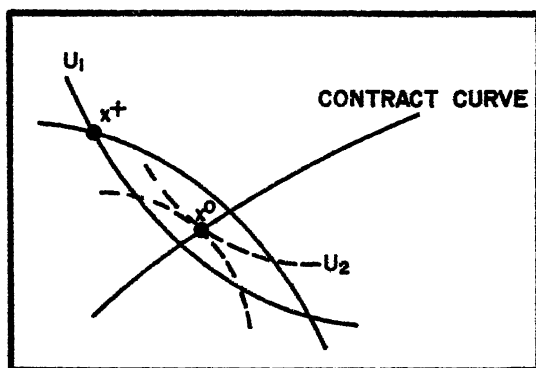


FIGURE 1. AN EDGEWORTH BOX REPRESENTATION OF A TWO-PERSON BARGAINING

given bargainer, the better off, in relative terms, will he emerge from the negotiated solution. The scope of this paper is to present some experimental data that validate a set of hypotheses derived from those remarks.

### I. *The Basic Hypotheses*

Before going into a description of the experimental procedures, I shall summarize the theoretical arguments that underlie the basic hypotheses.

The static analysis of bargaining implicitly assumes that the value of time is zero, or, more precisely, that there is no cost associated with the search for an agreement. In terms of a classical Edgeworth box, it is therefore appropriate to argue that a movement from a nonoptimal position  $x^+$  to a position  $x^0$  on the contract curve (see Fig. 1) is advantageous for both parties, and that, consequently,  $x^+$  cannot be a "stable" outcome of the bargaining process if both players behave rationally. The introduction of the time element in this model merely indicates that  $x^0$  today is not the same thing as  $x^0$  a year from now, and that, for that matter,  $x^+$  today could be better than  $x^0$  a year from now, even if it is clearly true that  $x^+$  today is not as good as  $x^0$  today.

Consider the following "dynamic" reinterpretation, as described by Figure 2. First, assume that each player's utility is a function of the commodity vector  $x$  over which agreement is to be found, as well as of time  $t$ ; denote it by  $U_i(x, t)$ . Assume also that both players are "impatient" in the Fisherian sense, i.e.,  $\partial U_i / \partial t < 0$ ,<sup>1</sup> and, for additional simplicity, that their "impatience structure" is completely characterized

<sup>1</sup> This assumption is sufficient to make the point. In general, however, not only will bargainers be "impatient" but they will also bear the objective costs associated with the negotiatory process. The presence of such costs would make my argument even stronger.

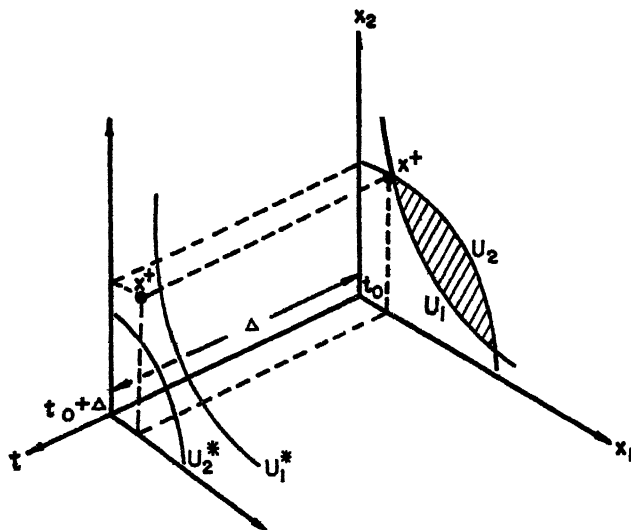


FIGURE 2. A "DYNAMIC" EDGEWORTH BOX WITH FIXED TIME  $\Delta$  FOR NEGOTIATIONS

by a positive discount factor. Let  $x^+$  be the status quo, and  $\Delta$  be the (known) minimum time that can be spent in negotiations.

Any point in the shaded area at time  $t_0$  is preferred to  $x^+$  for both players. But in order to move away from  $x^+$  and find an agreement elsewhere, it takes  $\Delta$  time-units. If the utility of  $x^+$  at  $t_0$  for players 1 and 2 corresponds to the indifference curves  $U_1^*$  and  $U_2^*$  at  $t_0 + \Delta$ , there may be no incentive to engage in the negotiations for either player as  $x^+$  yields a higher utility than any position attainable  $\Delta$  units of time thereafter. Notice that, under the usual assumption that each player knows only his own utility function, we cannot say that  $x^+$  must be stable even if we assume that  $\Delta$  is known by both. It may or it may not, depending upon each player's beliefs concerning his opponent's utility. Only if we assume also perfect knowledge of each other's utilities, can we state that  $x^+$  is a stable solution.

The stability of a negotiated solution is a direct consequence of the players' rationality. Therefore, in a timeless world individual rationality is usually sufficient to insure that a negotiated solution will also have certain "welfare" characteristics, namely that it should be efficient.

In a dynamic model this is no longer true. A solution may be stable, yet undesirable under the standard welfare criterion of "efficiency." For analytical purposes, it is possible to redefine efficiency in a dynamic context [2, pp. 13-14], but the essence of the problem does not change. Consider, in Figure 1 the allocation  $x^0$  on the contract curve, and assume that it is the status quo at time 0. It is possible that neither party will

be willing to accept such a status quo at time 0, in the hope of forcing the opponent to agree on some other position, more favorable to him than  $(x^0, 0)$ . However, no such agreement can be forthcoming and the parties will have to take the status quo at some later date, say  $T$  time periods thereafter. Clearly,  $(x^0, 0)$  is not a stable solution. Both  $(x^0, 0)$  and  $(x^0, T)$  are "dynamically efficient" according to the new definition, but  $(x^0, 0)$  dominates  $(x^0, T)$ .

Similar arguments can be used to support the second of the two claims made at the beginning of this paper. A bargainer, whose time discount rate is high, will tend to regard his time comparatively more valuable than a bargainer with a low discount rate. Thus, it may be expected that he will be willing to agree on a comparatively less advantageous deal if it allows him to "save" time. For a player with a low discount rate time is a relatively cheap commodity; he will presumably hold out longer in the negotiatory process, and eventually be able to force the opponent to accept his demands. As has been pointed out, this conclusion becomes even stronger if it is assumed that differential bargaining costs are borne by the players. Several examples from the real world can be drawn to support such a view. Collective bargaining disputes provide a good case study. When a strike is called the party who can hold out for the longest time is likely to have it won. Part of the bargaining strategy may consist in convincing the opponents (whether true or not) that "we can hold out longer than you" which usually implies "your time is more valuable than ours."

This observation is not without precedents. Bishop [1] and Foldes [6] have reached sufficiently similar conclusions from models of bargaining that incorporate some elements of both Zeuthen's and Hicks's formulation [12] [8]. Cross's findings are more ambiguous: *ceteris paribus*, the higher each player's discount rate, the less favorable to him will be the negotiated solution; however, the discount rates also affect the players' learning rates in the negotiatory process, and this may reverse the above conclusion.

The experimental study described here aims at providing empirical evidence for the following propositions: (a) the larger the two players' evaluation of time (i.e., a reflection of their time preference structure, as well as any fixed cost incurred in the negotiatory process), the faster will a stable solution be found; (b) the larger the players' evaluation of time, the smaller the likelihood that the negotiated solution will be efficient in the static sense; (c) the larger one player's evaluation of time as compared to his opponent's, the lower his bargaining power, i.e., the less favorable to him will the negotiated solution be.

This paper is a natural extension of the pioneering study by Siegel and Fouraker in 1960 [11].

The experimental context is a bilateral monopoly market, a close replica of the one designed by my predecessors. Siegel and Fouraker's main findings can be summarized as follows:

1. There is a tendency for bargainers to maximize joint payoff by negotiating contracts on the contract curve (Pareto-optimal).
2. Increasing the amount of relevant information available to bargainers increases their tendency to maximize joint payoff; moreover, this leads them to a more equal division of the joint payoff.
3. Consideration of traditional economic forces do not yield an adequate explanation of the negotiated prices. Personal characteristics of the bargainers, namely their aspirations, seem to be important determinants of differential payoff and price.

## II. *Design of Experiments*

The manipulation of a subject's evaluation of time as a control variable in an experimental setup raises some practical difficulties. In theory, one would want to control both the time discount factor in the subject's utility and the fixed cost recurring at each stage of bargaining. While the latter presents no special problems, we are not aware of any acceptable method of manipulating the former in short experimental sessions. It was therefore decided to introduce only a fixed monetary penalty proportional to the number of rounds of bargaining necessary to reach an agreement, and to consider it as a proxy variable for a subject's evaluation of time. The penalty, known in advance to each player, was to be deduced from the final gross payoff on which agreement would be reached. One round of bargaining was defined as a bid of one player, followed by a counter bid of the rival, not leading to agreement. Each bid consisted of a pair "price-quantity" for both buyer and seller.

The payoff to each bargainer was computed as follows,

$$\begin{aligned} \text{net payoff} &= \text{final negotiated payoff} \\ &\quad - (\text{penalty} \times \text{number of rounds of bargaining prior to agreement}). \end{aligned}$$

This method considerably simplifies matters both for the experimenter and for the subjects. No serious unwarranted assumption is introduced in the design by this simplification.

The primary effect of a high penalty should be to reduce the length of the negotiations. This suggests the first hypothesis to be tested in our experiments, namely that the number of rounds of negotiation prior to agreement will be smaller when both participants are bearing a large penalty than if both were incurring a low cost of bargaining. Secondly, it would seem that a high penalty should make more perceptible the difference between a "stable" and an "efficient" (or Pareto-optimal)

solution (in the sense outlined at the beginning of this paper). Thus a high penalty ought to reduce the tendency to negotiate contracts on the Paretian optima. This constitutes our second hypothesis. Thirdly, we shall investigate the effect of a differential penalty on the outcome of the bargaining. The hypothesis to be tested is that an imbalance in the penalty will affect the outcome of the negotiations in favor of the party with the lower cost.

Two additional hypotheses were generated, in which the effect of the differential penalty was combined with the two variables found significant in the Siegel and Fouraker experiments, e.g., the amount of information and the level of aspiration. Both were aimed at giving a stronger validation to the basic hypothesis on the effect of an asymmetric penalty structure on bargaining power.

The model of bilateral monopoly of our experiments is identical to the one used by Siegel and Fouraker. The object of transaction is a unique product, for which no close substitutes are available. As is well known, in such a model there is a unique optimal quantity  $Q^*$  for which joint profits are maximized, while the division of profits is determined by the price at which the transaction is made. All profits go to the buyer if the negotiated price is  $p_s$ , equal to the seller's average cost; all go to the seller if price is  $p_b$ , equal to the buyer's average revenue. Any transaction involving the optimal quantity  $Q^*$  and a price included between  $p_s$  and  $p_b$  is Pareto-optimal.

Average cost and revenue functions were chosen as follows.

$$\frac{C(q)}{q} = 6 + .4q; \quad \frac{R(q)}{q} = 20 - q.$$

The associated profit functions were then scaled down by a common proportionality factor so as to yield a maximum joint profit of \$10.20, corresponding to an optimal quantity of 9.<sup>2</sup> The profit tables for buyer and seller are given in Tables 1 and 2.

Due to University regulations all subjects were insured a minimum gain at the rate of \$1.81 per hour. This feature provided a natural status quo position for the bargainers. Each knew that he could impose the same amount of reward on his opponent by provoking a deadlock. That is, if he felt that his opponent was holding out for an unfair profit, the subject could carry out the implicit threat and impose an equal division of gains at the guaranteed low level.

<sup>2</sup> The given cost and revenue functions yield a maximum joint profit of \$35 at an optimal quantity of 5 units. Profits were scaled down by a factor of 102/350. Moreover, in order to avoid bids in terms of non-integer figures, both quantities and prices were relabelled as shown in the profit tables. Originally quantities ranged from 1 to 9.5. Prices were relabelled by letters. It should be noticed that the parameters of the cost and revenue functions adopted in this study differ from those used in the Siegel-Fouraker model.

TABLE 1—BUYER'S PROFIT TABLE  
(Price in Dollars)

Quantity	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50	11.00	11.50	12.00	12.50	13.00	13.50	14.00	14.50
1	370	356	342	328	314	300	285	270	255	240	225	210	196	182	168	154	140	125
2	560	539	518	496	475	454	433	412	390	369	348	327	305	284	263	251	230	209
3	687	660	631	603	575	547	519	490	462	434	406	378	350	322	294	266	238	210
4	750	715	680	645	610	575	540	505	470	435	400	365	330	295	260	225	190	165
5	933	890	845	800	755	710	665	620	575	530	485	440	395	350	305	260	215	170
6	940	890	840	790	740	690	640	590	540	490	440	390	340	290	240	190	140	90
7	1030	970	915	855	800	740	685	625	570	510	455	400	340	285	225	170	90	25
8	1200	1140	1075	1015	950	890	825	760	595	630	570	505	440	380	315	250	190	130
9	1300	1230	1160	1090	1020	950	880	810	740	670	600	530	460	390	320	250	180	110
10	1340	1260	1185	1105	1030	950	875	800	720	640	560	485	410	335	255	180	100	25
11	1355	1270	1185	1100	1015	930	845	760	685	600	515	430	345	260	175	90	5	-80
12	1360	1270	1180	1090	1000	910	820	730	640	550	460	370	280	190	100	10	-80	-170
13	1375	1275	1175	1075	975	875	775	675	575	475	375	275	175	75	-25	-125	-225	-325
14	1375	1270	1160	1055	945	840	730	625	515	410	300	200	90	-20	-125	-235	-340	-450
15	1350	1240	1125	1015	900	790	675	565	450	340	330	115	0	-110	-225	-340	-450	-560
16	1340	1220	1100	975	850	730	610	485	360	250	125	0	-125	-245	-360	-480	-505	-630
18	1300	1170	1040	910	790	660	540	390	260	130	0	-125	-250	-380	-510	-635	-760	-890
18	1250	1110	970	830	695	560	420	280	140	0	-135	-270	-405	-540	-630	-815	-950	-1040

The profits are derived from the demand curve for your firm.

TABLE 2—SELLER'S PROFIT TABLE  
(Price in Dollars)

Quantity	6.00	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50	11.00	11.50	12.00	12.50	13.00	13.50	14.00	14.50
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	-11	3	17	31	45	59	73	87	101	115	129	145	159	173	187	201	215	229
2	-29	-8	13	34	57	78	100	121	143	164	185	206	228	249	271	292	313	334
3	-46	-18	11	40	68	96	124	153	181	209	237	265	293	321	349	377	405	433
4	-75	-40	-4	30	64	101	135	172	206	243	280	314	351	385	422	456	490	527
5	-103	-60	-18	25	67	110	152	195	237	280	322	385	427	470	512	555	597	640
6	-140	-90	-45	0	50	95	145	190	240	285	335	380	430	485	535	580	630	675
7	-184	-130	-70	-10	45	105	160	220	275	335	390	450	505	560	620	675	730	790
8	-231	-171	-102	-41	30	92	157	220	285	347	410	480	545	610	672	735	800	862
9	-285	-215	-140	-70	0	70	140	210	280	350	420	490	560	630	700	770	840	915
10	-372	-300	-220	-145	-65	10	90	165	245	320	400	475	555	630	710	785	865	940
11	-447	-360	-275	-190	-85	5	85	165	250	335	420	505	590	675	760	850	935	1020
12	-493	-400	-310	-215	-125	-30	60	155	245	340	430	525	615	710	800	895	985	1080
13	-558	-458	-348	-258	-158	-58	42	142	242	342	442	542	640	740	840	941	1042	1140
14	-657	-555	-450	-335	-220	-115	0	115	220	330	440	550	665	780	895	1010	1125	1230
15	-750	-620	-500	-390	-280	-170	-60	50	160	270	380	490	600	720	840	960	1080	1200
16	-837	-690	-565	-445	-320	-185	-65	20	140	260	385	510	635	755	875	1000	1120	1240
17	-924	-800	-670	-540	-410	-290	-160	-30	100	230	360	490	620	750	880	1030	1160	1290
18	-1027	-920	-780	-640	-500	-360	-220	-80	60	200	340	480	620	760	930	1040	1180	1320

The profits are derived from the supply curve of your firm.



A total of 50 bargaining pairs were observed in five different Experimental Sessions. The experiment was designed according to the following scheme.<sup>3</sup>

INFORMATION STRUCTURE					
Incomplete				Complete/Incomplete	
Level of Aspiration		Level of Aspiration			
High	Not controlled	High	Not controlled		
Symmetrical penalty	High	—	—		10
	Low	—	—		10
Asymmetrical penalty	Differential	10	10		30
		10	30		50

### III. Results of Experiments

In this section I report on the experimental studies that were carried out to test the first two hypotheses developed in the previous section.

The first hypothesis predicts that the negotiations in which both participants are incurring large costs of bargaining will be shorter in duration than the negotiations in which there is no penalty levied on either party. Two sets of experiments were conducted in order to test this hypothesis (referred to as Experimental Sessions I and II). Ten bargaining pairs were run in each set of experiments. Experimental Session I was an exact replica of the Siegel-Fouraker experiments under incomplete information, except for the parameters used to generate the profit tables. No penalty was assessed on either player. Experimental Session II differed from the previous one in that a penalty of 10 cents per round of bargaining was imposed on both players.<sup>4</sup> All subjects in Experimental Sessions I and II bargained under conditions of incomplete information, i.e., they had access only to their own profit matrix and knew only their own penalty. The observations from Experimental Sessions I and II are summarized in Tables 3 and 4.

All ten pairs participating in Experimental Session I were able to reach an agreement within the hour time limit. Only eight pairs out of

<sup>3</sup> For detailed information on the experimental procedures, see [3]. The sample included 100 subjects, all students at the University of California in Berkeley. Each subject was randomly assigned to only one experiment. In order to maintain a minimum degree of homogeneity in the sample, the subjects were selected among the following majors: business administration, economics and engineering. The great majority were upper division undergraduates; all of them males, except two.

<sup>4</sup> This amount was arrived at after interviewing subjects participating in pilot-experiments in which various amounts were used. Ten cents appeared to be a reasonable figure because it was large enough so that it would not be ignored but not excessive in relation to the negotiable payoffs.

TABLE 3—CONTRACTS NEGOTIATED BY BARGAINING PAIRS IN EXPERIMENTAL SESSION I

Number of Transactions	Quantity	Price	Gross Profits		
			Buyer	Seller	Joint Payoff
25	10	12.50	3.35	6.30	9.65 <i>N</i>
32	9	10.50	6.70	3.50	10.20 <i>O</i>
19	9	11.00	6.00	4.20	10.20 <i>O</i>
8	9	10.50	6.75	3.50	10.20 <i>O</i>
50	10	11.00	5.60	4.00	9.60 <i>N</i>
21	9	10.00	7.40	2.80	10.20 <i>O</i>
20	9	11.00	6.00	4.20	10.20 <i>O</i>
12	9	11.00	6.00	4.20	10.20 <i>O</i>
38	9	11.00	6.00	4.20	10.20 <i>O</i>
12	9	12.00	4.60	5.60	10.20 <i>O</i>
Mean 23.7	9.2	11.05	5.84	4.25	10.09

Buyer's gross payoff larger than Seller's 8 pairs

Seller's gross payoff larger than Buyer's 2 pairs

10

ten reached a settlement in Experimental Session II; in two cases the negotiations came to an end because one player decided to withdraw from the bargaining. The means in Table 4 were calculated omitting these observations.

The mean number of transactions in Experimental Session I was 23.7

TABLE 4—CONTRACTS NEGOTIATED BY BARGAINING PAIRS IN EXPERIMENTAL SESSION II

Number of Transactions	Quantity	Price	Gross Profits		
			Buyer	Seller	Joint Payoff
5	8	11.00	5.70	4.10	9.80 <i>N</i>
2	10	12.00	4.10	5.55	9.65 <i>N</i>
22	9	11.00	6.00	4.20	10.20 <i>O</i>
14	9	10.50	6.70	3.50	10.20 <i>O</i>
20	9	10.00	7.40	2.80	10.20 <i>O</i>
3	9	10.50	6.70	3.50	10.20 <i>O</i>
14	9	9.50	8.10	2.10	10.20 <i>O</i>
4	9	10.00	7.40	2.80	10.20 <i>O</i>
*20	—	—	Quit	—	hourly rate <i>N</i>
*54	—	—	—	Quit	hourly rate <i>N</i>

(\*) Means do not include these observations

Buyer's gross payoff larger than Seller's 7 pairs

Seller's gross payoff larger than Buyer's 1 pair

Status quo (quits) 2 pairs

10

while in Experimental Session II it was 10.5. Thus, the observed results are in the right direction to support the hypothesis.

We tested the null hypothesis that the two samples of observations on the length of each experiment come from the same population, against the alternative hypothesis that they belong to two populations, one of which is stochastically larger than the other. The appropriate test is the (nonparametric) Mann-Whitney U test, defined by

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R_1,$$

$n_1$  = number of observations in the smaller sample,

$n_2$  = number of observations in the larger sample,

$R_1$  = sum of the ranks assigned to observations in sample of size  $n_1$ .

We find  $U = 15$  with  $n_1 = 8$  and  $n_2 = 10$ . The critical value of the test at level  $\alpha = .025$  is  $U = 17$  [see 10, Tables K and I]. We can, therefore, reject the null hypothesis, and conclude that the results of Experimental Sessions I and II strongly support the hypothesis that the cost of bargaining influences the length of time necessary to reach an agreement in situations of bilateral monopoly.

The second hypothesis predicts that the frequency of Pareto-optimal contracts will be lower, the higher the penalty assessed on the two contestants. In Experimental Session I (Table 3) all ten pairs reached an agreement, eight of which at the quantity that maximizes joint profit,  $Q^* = 9$ ; the remaining two pairs came to a solution in correspondence to the quantity  $Q = 10$ , i.e., only one unit away from the optimal quantity. In Experimental Session II, however, two pairs failed to reach any agreement; in one case it was the Seller who quit, in the other case it was the Buyer.<sup>5</sup> Of those who came to a negotiated solution, six maximized their joint gross payoff, and two settled for quantities only one unit away from  $Q^* = 9$ .

The results appear to be in the direction predicted by the theory, but not so convincingly as in the previous hypothesis. For instance, we find surprisingly high the number of pairs that reached a Pareto-optimal position (in gross terms) in Experimental Session II (6 out of 10).

An *ad hoc* binomial test based on the classification of all twenty pairs in the two Sessions I and II as "optimal" (O) and "non-optimal" (N) (according to the size of the negotiated joint payoff) suggests that the observations from Experimental Session II do not belong to the same

<sup>5</sup> Actually this pair closed the bargaining on a contract which called for a raw loss of \$3.60 for the Buyer. The Buyer explained that his penalty had made it uneconomical to continue bargaining after 20 rounds of negotiations. Rather than quit he accepted a loss presuming that he would not be asked to pay it, and that, instead, he would receive the guaranteed hourly rate. He hoped to obtain a side-payment from his opponent after the session was over.

population as the observations from Experimental Session I at a level of significance equal to 87.8 per cent. This inference supports the underlying theory, although, admittedly, in a somewhat more modest fashion than was initially expected.<sup>6</sup> Additional testing is therefore needed to provide conclusive evidence in this hypothesis.

#### IV. *Asymmetrical Penalty Structure*

I shall now discuss the effect of introducing an asymmetrical penalty structure in our experimental setup.

A more critical look at the results of Experimental Sessions I and II will help to rationalize the design of the three remaining sets of experiments. In those two sessions the Buyer's average profit ( $\bar{\pi}_B$ ) was clearly higher than the Seller's ( $\bar{\pi}_S$ ). In Session I the Buyer did better than the Seller 8 times out of 10; average profits were  $\bar{\pi}_B = 5.84$  vs.  $\bar{\pi}_S = 4.25$ . In Session II, the Buyer did better than the Seller 7 times out of 8 pairs in which agreement was found; average profits were  $\bar{\pi}_B = 6.51$  vs.  $\bar{\pi}_S = 3.51$ .

These data suggest that the game is substantially biased in favor of the Buyer. The imbalance is so clear that there is no need to resort to statistical testing for confirmation. The reason appears to be due to an asymmetry of the profit matrices. In fact, the geometrical center of the profit table does not coincide with the equal division of joint profits; the former occurs at a price of \$10.25, while the latter coincides with a price of \$11.65. Contrary to any postulate on the "independence of irrelevant alternatives," the tendency toward negotiating contracts in the vicinity of the geometrical center of the profit tables seems to have been remarkably strong. At the geometrical center of the matrices, the Buyer's profit is more than twice the Seller's. This bias was not intentionally designed in the experiment, but, *a posteriori*, it turned out to be a useful feature for the following reasons: (1) it provides an easy way of testing the *relevance* of "irrelevant alternatives" in bargaining situations;<sup>7</sup> (2) it provides a "natural" design for the assessment of differential penalties on the two bargainers, as is indicated in what follows.

<sup>6</sup> It would be possible to test the same hypothesis on the basis of the data on the joint profits agreed upon by each pair. This procedure would however raise some problems due to the difficulty of comparing gross joint profits with net figures without due account for the number of transactions in each bargain.

<sup>7</sup> This can be done by replicating Experimental Sessions I and/or II with the same set of profit tables, except for the range of prices that should be modified as follows: smallest price equal to \$8.00, largest price equal to \$16.50. This amounts to chopping off the first four columns of the profit tables, and adding four at the end. The geometrical center is thus shifted at the price \$12.25, in correspondence of which the Seller's profit is slightly larger than the Buyer's. If such a modified game shifts the bias in favor of the Seller, as I would strongly suspect at this point, it will contribute a blatant violation of the so-called independence of irrelevant alternatives. It has been suggested to me that experienced bargainers may not fall into this trap so easily as the inexperienced subjects that were used in our experiments. This may be true, but, as yet, no evidence is available to confirm it.

TABLE 5—CONTRACTS NEGOTIATED BY BARGAINING PAIRS IN EXPERIMENTAL SESSION III

Number of Transactions	Quantity	Price	Gross Profits		
			Buyer	Seller	Joint Payoff
28	11	12.00	3.45	5.90	9.35 <i>N</i>
12	9	11.50	5.30	4.90	10.20 <i>O</i>
16	9	11.50	5.30	4.90	10.20 <i>O</i>
21	9	11.00	6.00	4.20	10.20 <i>O</i>
23	9	12.50	3.90	6.30	10.20 <i>O</i>
12	10	10.50	6.40	3.20	9.60 <i>N</i>
9	9	12.00	4.60	5.60	10.20 <i>O</i>
16	9	11.50	5.30	4.90	10.20 <i>O</i>
*57	—	—	Quit	—	hourly rate <i>N</i>
*35	—	—	Quit	—	hourly rate <i>N</i>
Mean 15.9	9.38	11.56	5.04	4.99	10.03

(\*) Means do not include these observations

Buyer's gross payoff larger than Seller's 5 pairs

Seller's gross payoff larger than Buyer's 3 pairs

Status quo (quits) 2 pairs

10

The hypothesis to be tested in Experimental Session III states that an imbalance in the induced bargaining costs will affect the negotiations in favor of the party who has been assessed the lower penalty. We decided to assess the high penalty to the Buyer and the low penalty to the Seller. According to the theory this will tend to shift the negotiated contracts towards a more equitable equilibrium, by counterbalancing the built-in bias in favor of the Buyer. Ten pairs of subjects participated in Experimental Session III. The session was conducted exactly in the same manner as the previous two, and identical profit tables were used. The only difference concerned the size of the penalty. Subjects who were to play the role of the Buyer were assessed a penalty of 10¢ per round; those playing the role of the Seller were told that they would incur no cost of bargaining. As in the previous experiments, no subject was given any information on the penalty being incurred by his opponent, nor on his profit table. The results are summarized in Table 5. Two out of the ten bargaining pairs were unable to reach an agreement. In both cases it was the Buyer who quit the negotiations.

At first glance it appears that the results are in the direction predicted by the theory. The average gross profit of Buyer and Seller is almost equal, showing the Seller's substantial improvements over the previous sessions. The mean number of transactions is roughly half-way between the means of Sessions I and II. Statistical testing is performed by comparing the final gross payoffs of either the Buyer or the Seller in Experi-

mental Session III with the respective payoffs attained in Sessions I and II. The results of the first two experiments can be pooled together as in both we used a symmetrical penalty structure.

The Mann-Whitney U-test with sample sizes  $n_1=8$  and  $n_2=18$  is used to test the null hypothesis that the two samples are drawn from the same population, against the alternative hypothesis that the parent populations are different and that one is stochastically larger than the other. The value of the U-statistic is given by  $U=31$  which is significant at the 97.5 per cent confidence level.

It is thus confirmed that the asymmetry in the penalty structure influences the balance of bargaining power; in bilateral negotiations the higher one's penalty relative to the rival's, the less advantageous one's final position (in gross terms) at the end of the negotiatory process. In this set of experiments the Buyer's average gross profit,  $\bar{\pi}_B=5.04$ , is still slightly larger than the Seller's,  $\bar{\pi}_S=4.99$ , but the difference has become almost insignificant. Moreover, the Buyer did better than the Seller in 5 out of 8 sample observations.<sup>8</sup>

Finally, it is worthwhile noticing that, in the two cases in which a deadlock was provoked, it was the Buyer who chose to do so. In both cases the bargainers had already gone through prolonged negotiations (57 rounds of bargaining in one, and 35 in the other). This observation is also in accordance with the underlying theory.

### V. Further Experiments

Experimental Sessions IV and V were designed to provide additional confirmation of the effect of asymmetric bargaining costs under different institutional arrangements suggested in the Siegel and Fouraker study.

The first set of experiments was conducted to determine the influence of varying degrees of information. The hypothesis to be tested, a straightforward extension of a parallel hypothesis by Siegel and Fouraker, originally due to Schelling [9], is that, under conditions of complete-incomplete information, the bargainer who is given complete information will come out with a smaller gross payoff than he would have had he possessed only incomplete information. This will occur as the latter will realize that it may be difficult for his opponent to see the "moralistic or legalistic" merits of the fifty-fifty contract, and therefore he may feel obliged to make concessions to avoid a stalemate.

Experimental Sessions III and IV were used to test this hypothesis. Ten bargaining pairs participated in Experimental Session IV. The procedures and the profit tables were the same as in the previous experiments. The Buyers were assigned a penalty of 10¢, and the Sellers a

<sup>8</sup> It goes without saying that the Seller's average net profit is substantially higher than the Buyer's, due to the fact that Sellers were charged a zero penalty, while the Buyers were assessed 10¢ per round of bargaining.

TABLE 6—CONTRACTS NEGOTIATED BY BARGAINING PAIRS IN EXPERIMENTAL SESSION IV

Number of Transactions	Quantity	Price	Gross Profits		
			Buyer	Seller	Joint Payoff
26	9	11.50	5.30	4.90	10.20 <i>O</i>
29	10	11.00	5.60	4.00	9.60 <i>N</i>
23	9	12.50	3.90	6.30	10.20 <i>O</i>
8	9	12.50	4.60	5.60	10.20 <i>O</i>
17	9	11.00	6.00	4.20	10.20 <i>O</i>
18	9	12.00	4.60	5.60	10.20 <i>O</i>
1	10	12.00	4.10	5.55	9.65 <i>N</i>
19	9	12.50	3.90	6.30	10.20 <i>O</i>
* 7	—	—	Quit	—	hourly rate <i>N</i>
*25	—	—	negotiations called off after one hour	—	hourly rate <i>N</i>

(\*) Means do not include these observations

Buyer's gross payoff larger than Seller's	3 pairs
Seller's gross payoff larger than Buyer's	5 pairs
Status quo (quits)	1 pair
No agreement	1 pair

10

zero penalty. The Buyer had his own profit table, while the Seller was given the Buyer's profit table as well as his own (actually the two tables were combined in one larger table to facilitate the reading). As in other sessions, no subject was given any information concerning the penalty or information conditions assigned to his opponent. In the Siegel-Fouraker experiments, however, the subjects with complete information were told that their opponent had access only to their own profit table. The difference turns out to be rather significant and appears to have interesting theoretical implications. The observations from Experimental Session IV are shown in Table 6. In one case the two bargainers were unable to reach any agreement at the end of the period assigned to them. In another case no agreement was negotiated as the Buyer quit.

According to our hypothesis, one should expect the average gross payoff to the Seller in Session III to be larger than in Session IV. As can be observed from Tables 5 and 6 the experimental data yield a diametrically opposite relation. The Seller's mean payoff in Session IV is \$5.31; the equivalent figure from Session III was \$4.99. Moreover, the Seller did better than the Buyer 5 times out of 8 in Session IV, while in Session III he had done better only 3 times in 8.

This finding suggests an interesting speculation. The hypothesis advanced by Siegel and Fouraker predicts that the bargainer with incomplete information may have an advantage over a rival with complete

information as the latter will realize that the opponent may be unable to see the merits of a "fair" agreement. In Experimental Session IV, however, the bargainers with complete information, namely the Sellers, were not told that their opponents had a more limited amount of information. They were free to believe whatever they saw fit. Thus they were not in a position to make this type of rationalization.<sup>9</sup> It becomes, therefore, reasonable to suspect that in these circumstances the Sellers would take full advantage of their position, without any incentive to make large concessions.

The results of Experimental Session IV may be reinterpreted along these lines, and, insofar as our speculation can be regarded as a testable hypothesis, they seem to provide it with some support, although not statistically significant. These observations do not in any way contradict Siegel and Fouraker's findings; quite the contrary, our speculation suggests that "a little less" information may be preferable to "a little more." This is quite in line with their results, and also in agreement with Schelling's original idea.

The last set of data was generated in Experimental Session V. Here, both the individual level of aspiration and the cost of bargaining were used as control variables. The session was directed at providing additional support to our basic hypothesis on the effects of differential penalties in the presence of high—artificially induced—level of aspiration. The conditions on the penalty and the amount of information were the same as in Session III. That is, all subjects bargained with incomplete information; the Buyer was penalized 10¢ per round of negotiation, but there was no penalty on the Seller. A high level of aspiration was induced in all the subjects playing the role of the Seller according to a procedure similar to the one used by Siegel and Fouraker.<sup>10</sup>

Our hypothesis is a direct extension of another basic finding of the Siegel-Fouraker study: the bargainer with a high aspiration level will

<sup>9</sup> It is also true, however, that the "perfectly fair price" of \$11.65 which would yield a fifty-fifty split of the joint profits, was not available in the profit tables. The lack of a "prominent" solution (in Schelling's terms) may therefore contribute to the explanation of why such a rationalization was not made. I owe this observation to a referee's comment.

<sup>10</sup> All the subjects acting as Sellers in Experimental Session V were given the following short notice, in addition to the information sheet and payoff matrix.

*"Attention:* You will be given a chance to earn money in addition to your regular payoff according to the following scheme:

—If your final payoff is between \$5.00 and \$5.50 you will be given a chance to earn a bonus of \$2.00.

—If your final payoff is between \$5.51 and \$6.00 you will be given a chance to earn a bonus of \$3.00.

—If your final payoff is more than \$6.00 you will be given a chance to earn a bonus of \$4.00."

This notice provided the Seller with a figure upon which to base his aspirations. Of course, he did not know that this level was higher than what he would have been expected to attain without the extra inducement. If at the end of each experiment the Seller's payoff exceeded the above amounts, he was asked to guess his opponent's gross payoff within a  $\pm 10\%$  range. A correct guess would entitle him to the bonus.



TABLE 7—CONTRACTS NEGOTIATED BY BARGAINING PAIRS IN EXPERIMENTAL SESSION V

Number of Transactions	Quantity	Price	Gross Profits		
			Buyer	Seller	Joint Payoff
27	10	12.50	3.35	6.30	9.65 <i>N</i>
4	11	11.00	5.15	4.20	9.35 <i>N</i>
12	9	12.50	3.90	6.30	10.20 <i>O</i>
39	8	11.50	5.05	4.80	9.85 <i>N</i>
7	9	12.50	4.60	5.60	10.20 <i>O</i>
20	9	10.50	6.70	3.50	10.20 <i>O</i>
12	10	11.50	4.85	4.75	9.60 <i>N</i>
13	9	12.50	3.90	6.30	10.20 <i>O</i>
4	8	12.50	3.80	6.10	9.90 <i>N</i>
*57	—	—	Quit	—	hourly rate <i>N</i>
Mean 15.3	9.22	11.83	4.59	5.32	9.91

(\*) Means do not include these observations

Buyer's gross payoff larger than Seller's 4 pairs

Seller's gross payoff larger than Buyer's 5 pairs

Status quo (quit) 1 pair

—  
10

be able to force a negotiated solution more favorable to him than would be realized if both players had comparable aspiration. We expect the two control variables to cumulate their effects; thus, the average gross profit to the Seller should be higher in Session V (in which both the induced aspiration level and the asymmetry of the penalty structure act in the direction of strengthening his bargaining power) than in Session III (in which only the penalty structure acted in that direction). The experimental data are shown in Table 7. Nine pairs of bargainers reached an agreement within an hour. In one case the Buyer quit, provoking a deadlock after 57 rounds of negotiation.

The average gross profit to the Seller is \$5.32 against a figure of \$4.99 in Session III. The Seller's gross profit was higher than the Buyer's 5 times out of 9. The results are in the direction that supports the hypothesis. Applying the Mann-Whitney U-test to the two samples of gross profit earned by the Sellers in Sessions III and IV, we find that the null hypothesis cannot be rejected. The experimental data are not sufficient to support the hypothesis, although they are in the direction predicted by the theory.

## VI. Summary

The data generated in the five Experimental Sessions provide some validation to all the hypotheses discussed at the outset. The introduc-

tion of a penalty as a proxy for the cost of bargaining drastically cuts the time required to reach an agreement (measured in rounds of unfinished negotiations). Moreover, it reduces the frequency of contracts on the Paretian optima.

An asymmetric penalty structure gives a strong advantage to the player who is assessed the lower penalty. This result was found in all the three sets of experiments designed with such asymmetries; it is confirmed at a more aggregate level by pooling all the observations on the individual final payoffs in two large groups: (1) those generated in Sessions I and II in which the penalty structure was symmetrical; (2) those obtained in the last three sessions, in which the Buyer was assessed a penalty of 10¢ per round of negotiation, and the Seller a zero penalty.

The data below show the frequencies of "wins" and "losses" between the two bargainers, classified in the two groups.

	Equal penalty	Differential penalty	
$\pi_B > \pi_S$	15	12	27
$\pi_B < \pi_S$	3	13	16
	18	25	43

The built-in bias in favor of the Buyer has a decisive effect on the 18 pairs run under conditions of equal penalty (Experimental Sessions I and II); only three pairs negotiated an agreement in which the final payoff to the Seller was larger than the Buyer's; in all other cases the Buyer came out better off than his opponent. With an asymmetrical penalty structure (Sessions III, IV, V) the game becomes, practically, a fair one: half of the time the agreement was to the Buyer's advantage, half of the time it turned out favorable to the Seller. Previous tests have already indicated that the asymmetry of the penalty structure has a major impact on the negotiated solution. A  $\chi^2$ -test performed on the  $2 \times 2$  aggregated classification gives a strong confirmation to those findings. The theoretical frequencies, under the assumption of complete independence, are given by

	Equal penalty	Differential penalty	
$\pi_B > \pi_S$	11.3	15.7	27
$\pi_B < \pi_S$	6.7	9.3	16
	18	25	43

The test statistic is  $\sum_{ij}(E_{ij}-0_{ij})^2/E_{ij}=5.62$ , distributed as a  $\chi^2$  with one degree of freedom. The critical value at level  $\alpha=0.02$  is equal to 5.41. The null hypothesis can therefore be rejected at the 98 per cent confidence level.

A different hypothesis already tested on disaggregated data suggests that the observations on the Seller's gross payoff in group (2) should be stochastically larger than those belonging to group (1). Applying the Mann-Whitney non-parametric U-test, with  $n_1=18$  and  $n_2=25$ , one obtains the auxiliary z-statistic, defined as follows [10],

$$z = \frac{U - n_1n_2/2}{\sqrt{n_1n_2(n_1 + n_2 + 1)/12}} = 3.47.$$

With a sample statistic  $z=3.47$  the null hypothesis can be safely rejected at the 99.997 per cent confidence level, providing additional confirmation that the two samples come from different populations.

The theory provides also some indications on which player is more likely to provoke a deadlock in the negotiations, i.e., force the status quo and, thus, equal payments at the guaranteed low level. *Ceteris paribus*, it will be the player whose value of time is—comparatively—higher. The experimental data are in apparent agreement with such theoretical expectations. In the two sessions in which the penalty structure was symmetrical, two pairs quit before reaching an agreement: in one case it was the Buyer, in the other it was the Seller. In the three sessions characterized by asymmetrical penalties four pairs failed to reach an agreement: in all four the status quo was chosen by the Buyer, i.e., the party who was incurring the larger penalty.

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## TARIFFS AND TRADE IN GENERAL EQUILIBRIUM

*By* BO SÖDERSTEN AND KARL VIND\*

The theory of tariffs has a long history. It figured prominently in the classical tradition, spurred on by the controversy over free trade and protectionism. The interest in tariff theory has also been kept alive within a modern, neoclassical framework. Few are the years that have not seen some kind of contribution to the theory of tariffs.

Before burdening the public with a new article on the subject, an explanation might therefore be warranted. Even though much has been published, and even though the problem in its essence should not be difficult to deal with, we think that we are justified in saying that no simple yet general treatment of the problem has been given. This being the case, an attempt at solving the question of the effects of tariffs within the context of the standard trade model seems justifiable.

Now, what one means by the theory of tariffs is not completely clear. In fact, it consists of at least two quite distinct branches. The first branch deals with the effects of tariffs on prices, economic welfare, etc., under fully competitive conditions. The second branch discusses tariffs in the presence of market imperfections and distortions, and has so far dealt only with the fairly limited question of whether the tariff is a legitimate policy measure for dealing with a distortion, and with comparing tariffs with other means for correcting the distortions. We are, in this paper, concerned with the first type of tariff theory.

Even within this first type there typically exists a distinct cleavage between what might be called the positive theory of tariffs and the welfare side of the theory, between the effects of tariffs on prices and income distribution on the one hand, and the question of the optimum tariff on the other. Most economists would probably agree that such a cleavage has to exist because of the nature of the problems involved.

This point of view, while not being directly mistaken, is nonetheless superficial and has been one of the reasons why economists have tended to treat the theory of tariffs in a partial and incomplete fashion, relegating to different compartments variables that should have been treated at one and the same time. We will treat our problem within the confines of the standard two-by-two-by-two trade model, i.e., a model

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with two countries, producing and consuming two goods, using two factors of production.

One of the points of our paper is that we simultaneously deal with all the relevant variables in the general equilibrium framework—to be specific, that we solve the system with respect both to prices and to the real national income. We furthermore demonstrate that the effects of tariffs on the terms of trade and on the home market price ratio are neat and unambiguous, that a tariff always will improve a country's terms of trade and always will make imports more expensive, except in the limiting case of complete adaptability, where relative prices do not change. The difference between our results and accepted theory on this score, we maintain, depends on the fact that earlier writers have confounded a redistribution problem with the effects of tariffs and thereby complicated the analysis in an unnecessary way. A corollary of our result for the home market price ratio is that the effects on the income distribution are also clear-cut and that the Stolper-Samuelson theorem holds without qualifications in this regard. We then go on to treat the effects of a tariff on the national income in real terms and derive a new formula for the optimum tariff.

As we want to isolate the effects of tariffs on the two trading economies, we have constructed a very simple type of general equilibrium model that still is comprehensive and able to reflect the interrelationships that we regard as essential. One obvious difficulty is that if the model is too large one cannot solve it for the general case, and thus cannot get qualitative results. In order to get a manageable model, it has to be stripped down to the barest essentials while preserving its general equilibrium character. We have tried to do this by compressing the model to an equation system of eleven variables in eleven unknowns.

It is, however, not possible to say *a priori* what are essential features. Another model, with other assumptions, might give results that differ significantly from the ones derived from this model. It can only be said that the present model is one of the simplest types of general equilibrium models that can be constructed, and that one can hope that the simplifying assumptions on which it is built will not turn out to be critical in the sense that altering them would lead to significantly different results. At least our model is built on explicit theorizing; there are no hidden assumptions, and the meaning of the variables involved should be clear enough.

### *I. The Model and Its Solution*

Let us then numerate the variables used and set out the model.  $S_{1m}$  and  $S_{1x}$  stand for production of importables and exportables in Country I;  $S_{2m}$  and  $S_{2x}$  mean analogous things for Country II.  $C_{1m}$  and

$C_{1x}$  mean consumption of importables and exportables in Country I;  $C_{2m}$  and  $C_{2x}$  denote analogous magnitudes in Country II.  $Y_1$  and  $Y_2$  denote national income in the respective countries.  $P$  is equal to the price of Country I's export good (i.e., Country I's terms of trade), while we let the price of the other good—i.e., Country I's import good and Country II's export good—equal one. Finally,  $t_1$  and  $t_2$  are the tariff rates in the respective countries.

The model, then, consists of the following system of eleven equations.

$$(1) \quad Y_1 = S_{1m} + PS_{1x} + t_1 C_{1m}$$

$$(2) \quad Y_2 = S_{2x} + PS_{2m} + Pt_2 C_{2m}$$

These two equations are definitions that show that the national incomes in the two countries equal total production plus the tariff revenue.

$$(3) \quad C_{2m} - S_{2m} = S_{1x} - C_{1x}$$

$$(4) \quad C_{1m} - S_{1m} = S_{2x} - C_{2x}$$

The two above equations are equilibrium conditions. We assume that the price mechanism works so that markets always are cleared and trade is always balanced. Therefore, exports of Country I always equal imports of Country II, and vice versa.

$$(5) \quad Y_2 = C_{2x} + P(1 + t_2)C_{2m}$$

We have assumed that Say's law holds so that everything that is produced is consumed and there is no saving. Then the above identity holds, specifying that the sum of consumption of the two goods in Country II equals its national income.

$$(6) \quad S_{1m} = S_{1m}(S_{1x})$$

$$(7) \quad S_{2x} = S_{2x}(S_{2m})$$

With fixed factor endowments, and assuming full employment, the production possibility frontiers given by the two equations above are the constraints on production.

$$(8)^{1a} \quad P = -(1 + t_1) \cdot \frac{\partial S_{1m}}{\partial S_{1x}}$$

$$(9) \quad P(1 + t_2) = - \frac{\partial S_{2x}}{\partial S_{2m}}$$

We assume that competitive conditions hold for both economies.

<sup>1a</sup> The reader might observe that there is implicitly a functional relationship between  $S_{1x}$  and  $P$  (and analogously for  $S_{2m}$ ).  $S_{1x}$  can be written as a function of  $P$  and  $t_1$ . Cf. Södersten [14, p. 32].

Then two behavior equations like the ones above can be set out, showing that in equilibrium the relative commodity price ratio (with tariffs included) must equal the marginal rate of substitution.

$$(10) \quad C_{1m} = C_{1m} \left( \frac{Y_1}{1+t_1}, \frac{P}{1+t_1} \right)$$

$$(11) \quad C_{2x} = C_{2x}(Y_2, P(1+t_2))$$

We have finally two demand equations that say that demand for any of the goods in the respective country is a function of its national income and of relative prices.

We have now set out a simple, but complete, general equilibrium model in eleven unknowns. Four of the eleven endogenous variables refer to consumption of the two goods in the two countries, four to production, two to national incomes, and one to relative prices. There are two exogenous variables,  $t_1$  and  $t_2$ . We now assume that this set of equations has solutions for  $t_1$  and  $t_2$ , and we are interested in studying the effects of tariff changes on our endogenous variables. For this purpose we take differentials of equations 1-11. By so doing and by rearranging some terms, the following system of equations can be set out:

$$(1a) \quad dS_{1m} + PdS_{1x} + t_1 dC_{1m} = dY_1 - S_{1x} dP - C_{1m} dt_1$$

$$(2a) \quad dS_{2x} + PdS_{2m} + Pt_2 dC_{2m} = dY_2 - (S_{2m} + t_2 C_{2m}) dP - PC_{2m} dt_2$$

$$(3a) \quad dC_{2m} + dC_{1x} - dS_{1x} - dS_{2m} = 0$$

$$(4a) \quad dC_{1m} + dC_{2x} - dS_{1m} - dS_{2x} = 0$$

$$(5a) \quad dC_{2x} + P(1+t_2)dC_{2m} = dY_2 - (1+t_2)C_{2m}dP - PC_{2m}dt_2$$

$$(6a) \quad (1+t_1)dS_{1m} + PdS_{1x} = 0$$

$$(7a) \quad dS_{2x} + P(1+t_2)dS_{2m} = 0$$

$$(8a) \quad (1+t_1)^2 dS_{1x} = (1+t_1) \frac{\partial S_{1x}}{\partial P} dP - P \frac{\partial S_{1x}}{\partial P} dt_1$$

$$(9a) \quad dS_{2m} = (1+t_2) \frac{\partial S_{2m}}{\partial P} dP + P \frac{\partial S_{2m}}{\partial P} dt_2$$

$$(10a) \quad (1+t_1)^2 dC_{1m} = (1+t_1) \frac{\partial C_{1m}}{\partial Y_1} dY_1 + (1+t_1) \frac{\partial C_{1m}}{\partial P} dP$$

$$\left( \frac{\partial C_{1m}}{\partial Y_1} Y_1 + \frac{\partial C_{1m}}{\partial P} P \right) dt_1$$

$$(11a) \quad dC_{2x} = \frac{\partial C_{2x}}{\partial Y_2} dY_2 + \frac{\partial C_{2x}}{\partial P} (1+t_2)dP + P \frac{\partial C_{2x}}{\partial P} dt_2$$



The next step is to give an explicit solution of this system that will show the effects of tariff changes on all the dependent variables.

It is important to be careful when solving the system. One of the main points of this type of analysis is to reach qualitative results and to be able to demonstrate the interrelationships among all the variables involved. If one is not careful, it is easy to end up with results that involve extremely cumbersome expressions that are difficult to interpret in an economically meaningful way.

The most convenient way of solving the model that we have found is the following. We start by rewriting the first three equations of the derived form of the model, 1a, 2a, and 3a, so that they contain only  $dY_1$ ,  $dY_2$ , and  $dP$  as unknowns. That gives:

$$\begin{aligned}
 (1a') \quad dY_1 &= \frac{1}{1 + t_1 \left(1 - \frac{\partial C_{1m}}{\partial Y_1}\right)} \left\{ \left[ \frac{Pt_1}{1 + t_1} \frac{\partial S_{1x}}{\partial P} \right. \right. \\
 &\quad \left. \left. + t_1 \frac{\partial C_{1m}}{\partial P} + (1 + t_1)S_{1x} \right] dP + \left[ (1 + t_1)C_{1m} - \right. \right. \\
 &\quad \left. \left. \frac{t_1}{1 + t_1} \left( \frac{P^2}{1 + t_1} \frac{\partial S_{1x}}{\partial P} + \frac{\partial C_{1m}}{\partial Y_1} Y_1 + \frac{\partial C_{1m}}{\partial P} P \right) \right] dt_1 \right\} \\
 (2a') \quad dY_2 &= \frac{1 + t_2}{1 + t_2 \frac{\partial C_{2x}}{\partial Y_2}} \left\{ \left[ -P(1 + t_2)t_2 \frac{\partial S_{2m}}{\partial P} - t_2 \frac{\partial C_{2x}}{\partial P} + S_{2m} \right] \right. \\
 &\quad \left. + \left[ -P^2 t_2 \frac{\partial S_{2m}}{\partial P} + \left( P - \frac{Pt_2}{1 + t_2} \right) C_{2m} - \frac{Pt_2}{1 + t_2} \frac{\partial C_{2x}}{\partial P} \right] dt_2 \right\} \\
 (3a') \quad \frac{1}{1 + t_1} \frac{\partial C_{1m}}{\partial Y_1} dY_1 + \frac{\partial C_{2x}}{\partial Y_2} dY_2 + \left[ \frac{1}{1 + t_1} \frac{\partial C_{1m}}{\partial P} \right. \\
 &\quad \left. + (1 + t_2) \frac{\partial C_{2x}}{\partial P} + \frac{P}{(1 + t_1)^2} \frac{\partial S_{1x}}{\partial P} + \frac{P(1 + t_2)t_2}{(1 + t_1)^2} \frac{\partial S_{2m}}{\partial P} \right] dP = \\
 &\quad \left[ \frac{1}{(1 + t_1)^2} \left( \frac{\partial C_{1m}}{\partial Y_1} Y_1 + \frac{\partial C_{1m}}{\partial P} P \right) + \frac{P^2}{(1 + t_1)^3} \frac{\partial S_{1x}}{\partial P} \right] dt_1 \\
 &\quad + \left[ -P \frac{\partial C_{2x}}{\partial P} - P^2(1 + t_2) \frac{\partial S_{2m}}{\partial P} \right] dt_2
 \end{aligned}$$

The rest of the system, equations 4a to 11a, can also be expressed as linear combinations of  $dY_1$ ,  $dY_2$ ,  $dP$ , and the exogenous variables  $dt_1$  and  $dt_2$ . We can therefore solve the above equation system of three equations in three unknowns and get explicit solutions for  $dY_1$ ,  $dY_2$ ,

and  $dP$ . After this has been done we can substitute these expressions for  $dY_1$ ,  $dY_2$ , and  $dP$  into the rest of the system and get explicit solutions for the other eight endogenous variables.

In order to simplify the solution of our equation system we rewrite it in the following manner:

$$(1a'') \quad a_1 dX_1 - t_1 b_1 dP = - \frac{Pt_1}{1+t_1} \beta_1 dt_1$$

$$(2a'') \quad a_2 dX_2 + t_2 b_2 dP = - Pt_2 \beta_2 dt_2$$

$$(3a'') \quad t_2 dX_1 - t_1 dX_2 = 0$$

where:

$$(12) \quad a_1 = 1 + t_1 \left( 1 - \frac{\partial C_{1m}}{\partial Y_1} \right)$$

$$(13) \quad a_2 = 1 + t_2 \frac{\partial C_{2s}}{\partial Y_2}$$

$$(14) \quad dX_1 = dY_1 - S_{1s} dP - C_{1m} dt_1$$

$$(15) \quad dX_2 = dY_2 - (1+t_2)S_{2m} dP - PC_{2m} dt_2$$

$$(16) \quad b_1 = \frac{P}{1+t_1} \frac{\partial S_{1s}}{\partial P} + \frac{\partial C_{1m}}{\partial P} + S_{1s} \frac{\partial C_{1m}}{\partial Y_1}$$

$$(17) \quad \beta_1 = \frac{P}{1+t_1} \frac{\partial S_{1s}}{\partial P} + \frac{\partial C_{1m}}{\partial P} + C_{1s} \frac{\partial C_{1m}}{\partial Y_1}$$

$$(18) \quad b_2 = (1+t_2) \left[ P(1+t_2) \frac{\partial S_{2m}}{\partial P} + \frac{\partial C_{2s}}{\partial P} + S_{2m} \frac{\partial C_{2s}}{\partial Y_2} \right]$$

$$(19) \quad \beta_2 = (1+t_2) \left[ P(1+t_2) \frac{\partial S_{2m}}{\partial P} + \frac{\partial C_{2s}}{\partial P} + C_{2s} \frac{\partial C_{2s}}{\partial Y_2} \right]$$

When solving the equation system 1a''-3a'' we first take the inverse of its matrix:

$$(20) \quad \frac{1}{\Delta} \begin{bmatrix} b_2 & \frac{t_1}{t_2} b_1 & \frac{a_2}{t_2} b_1 \\ \frac{t_2}{t_1} b_2 & b_1 & -\frac{a_1}{t_1} b_2 \\ -\frac{a_2}{t_1} & \frac{a_1}{t_2} & \frac{a_1 a_2}{t_1 t_2} \end{bmatrix}$$

where the determinant is  $t_1 t_2 \Delta$  and where

$$(21) \quad \Delta = a_1 b_2 + a_2 b_1$$

Solving for our unknown three variables gives:

$$(22) \quad dX_1 = -\frac{Pt_1}{\Delta} \left( \frac{b_2 \beta_1}{1+t_1} dt_1 + b_1 \beta_2 dt_2 \right)$$

$$(23) \quad dX_2 = \frac{t_2}{t_1} dX_1$$

$$(24) \quad dP = \frac{P}{\Delta} \left( \frac{a_1 \beta_1}{1+t_1} dt_1 - a_1 \beta_2 dt_2 \right)$$

By substituting  $dX_1$ ,  $dX_2$ , and  $dP$  into our equation system we can get a complete solution to all the endogenous variables. We are therefore through with the mathematical manipulations and can go on to the economic analysis of our results.

## II. *The Terms of Trade, the Home Market Price Ratio, and Income Distribution*

We have already, in formula (24), established the results for the effects of a tariff on the terms of trade. The most striking fact about this result is that it is unambiguous: an increase in the tariff will always improve a country's terms of trade. The only exception, which we will soon come back to, is the case where the trading partner's supply or demand elasticities are infinitely large, in which case a tariff change will have no influence on the terms of trade.

We can also see that this result is symmetric in the sense that an increase in the second country's tariff will always turn the terms of trade against the first country, the only exception being the case where the first country's supply or demand elasticities are infinitely large, in which case the terms of trade will stay unchanged.

In order to look into the economic implications of expression (24) more closely, we will write it out in the following explicit way:

$$(25) \quad \frac{dP}{P} = \frac{1}{\Delta} \left\{ \frac{1}{1+t_1} \left( 1+t_2 \frac{\partial C_{2x}}{\partial Y_2} \right) \left( \frac{P}{1+t_1} \frac{\partial S_{1x}}{\partial P} + \frac{\partial C_{1m}}{\partial P} + S_{1x} \frac{\partial C_{1m}}{\partial Y_1} \right) dt_1 \right. \\ \left. - \left[ 1+t_1 \left( 1 - \frac{\partial C_{1m}}{\partial Y_1} \right) \right] (1+t_2) \left[ P(1+t_2) \frac{\partial S_{2x}}{\partial P} \right. \right. \\ \left. \left. + \frac{\partial C_{2x}}{\partial P} + C_{2m} \frac{\partial C_{2x}}{\partial Y_2} \right] dt_2 \right\}$$

Formula (25) shows that the most important factor for the magnitude of change of the terms of trade is the flexibility of the two trading

economies, measured by the four partial derivatives  $\partial S_{1x}/\partial P$ ,  $\partial C_{1m}/\partial P$ ,  $\partial C_{2m}/\partial P$ , and  $\partial C_{2x}/\partial P$ .<sup>1,2</sup>

Let us assume that Country I increases its tariff. If the consumers or the producers in Country II are very sensitive to changes in the relative price structure, i.e., if  $\partial S_{2m}/\partial P$  and  $\partial C_{2x}/\partial P$  are large, they will make considerable adjustment of quantities consumed and produced, and the changes in the terms of trade needed to bring about the new equilibrium will be small. So the more flexible a country's economy is, the more successful it will be in neutralizing the effects of changes in her trading partner's tariff policy.

The flexibility of the economy of the country that raises its tariff is also important. In order to bring out this point we assume that the second country does not change its tariff, and we rewrite formula (24) in the following manner:

$$(27) \quad \frac{dP}{dt_1} = \frac{P}{1+t_1} \frac{a_2\beta_1}{a_1b_2 + a_2b_1} \frac{P}{1+t_1} \frac{1}{\frac{a_1b_2}{a_2\beta_1} + \frac{b_1}{\beta_1}}$$

This shows that the larger the values of  $\partial S_{1x}/\partial P$  and  $\partial C_{1m}/\partial P$ , the more will the terms of trade improve for the country imposing the higher tariff.

The next, and maybe more interesting, result concerns the home market price ratio. We can write the relative price of the export good in terms of the import good (tariffs included) in the following way:  $P/1+t_1$ . Differentiating this expression and solving gives:

$$(28) \quad \frac{dP}{1+t_1} - \frac{Pd t_1}{(1+t_1)^2} = \frac{1}{\Delta} \left[ \frac{-}{(1+t_1)^2} (a_2\beta_1 - \Delta) dt_1 - Pa_1\beta_2 dt_2 \right]$$

Again we get a new, neat result. Formula (28) shows that the relative price of the export good will always fall on the home market and that the imported good will become more expensive because of the tariff. This result does not coincide with established theory; why this is so we will shortly return to. Before we do so, it is appropriate to say a few words about its significance for income distribution.

The classic result about the effects of a tariff on income distribution

<sup>1</sup> We have already somewhat loosely referred to these partial derivatives as supply and demand elasticities, as they measure exactly what demand and supply elasticities measure—that is, the sensitivity in the interrelationship between price and supply and demand. As our slightly lax, but convenient, use of language in this respect can hardly confuse anyone, we will continue to use it. Anyone who wants to can, of course, rewrite formula (25) in terms of elasticities. Cf. Södersten [14, pp. 36 *et seq.*].

<sup>2</sup> In the following discussion we assume that  $\partial C_{1m}/\partial P$  and  $\partial C_{2x}/\partial P$  are positive. This implies that  $\Delta$  is positive. Cf. Södersten [14, pp. 37 *et seq.* and pp. 60 *et seq.*].

is contained in the so-called Stolper-Samuelson theorem [15]. It says that the real reward of the factor used intensively in the import-competing industry will increase because of the tariff and that the reward of the other factor will fall because of the tariff. This result has been attacked by Metzler, who claims that it holds only in certain instances, depending upon the effects of the tariff on the home market price ratio [11] [12].

Formula (28) shows that the Metzler case can never occur. Therefore, if one is willing to accept the main assumption of the Stolper-Samuelson analysis, that of linearly homogeneous production functions, the Stolper-Samuelson result holds without exception and a tariff will always hurt the factor used intensively in the export industry.

Before we go on with the analysis, however, it is appropriate to stop for a moment and scrutinize the standard results; for this purpose we use the two classic articles by Metzler published in 1949 [11] [12].

### III. *Some Peculiarities of the Metzler Analysis*

Metzler's two articles are rightly regarded as containing the standard results for the effects of tariffs on prices.<sup>3</sup> Lucid and clear as they are, they are, however, marred by some peculiarities and by what we regard as a major misconception in the formulation of the problem at hand. As none of the later writers in the field has improved upon the Metzler analysis in any essential aspect, we have chosen his papers as representing existing theory.

Stolper and Samuelson assumed that a tariff would always increase the price of the imported good. Having assumed this, they were able to show the effects of a tariff on the income distribution in a straightforward manner. Metzler, however, contended that one could not always be sure that a tariff would increase the price of the imported good. There could be a case where the improvement in the terms of trade was so large as to offset the tariff and that therefore the relative price of the imported good would fall because of the tariff. If this were to happen, the Stolper-Samuelson result would be reversed and the tariff would benefit the factor used intensively in the export industry.

In his first article, Metzler set out the condition that, if  $\eta = 1 - k$ , the internal price ratio would be unaffected by the tariff.  $\eta$  was defined as the second country's demand elasticity for the first (tariff-imposing) country's exports, and  $1 - k$  was defined as the first country's marginal propensity to consume its export good. Only if the trading partner's demand elasticity for the tariff-imposing country's exports were larger

<sup>3</sup> For later contributions that, however, do not question Metzler's basic results, cf. Baldwin [1], and Bhagwati and Johnson [4]. For recent survey articles, covering the area, cf. Bhagwati [2] [3], and Chipman [6].

than the marginal propensity to consume exportables, would the price of the import good increase in the country levying a tariff; if its marginal propensity to consume its export good were larger than the foreign demand elasticity confronting its exports, imports would instead be cheaper because of the tariff.

The second paper aimed at correcting and elaborating this result from his first article. As that is the more interesting paper for our purpose, we will look at it more closely. In order to derive the effects of a tariff on the home market price ratio, Metzler set out the following model.

The demand function for the first country's imports he wrote as follows:

$$(a) \quad u_1 = f_1[(1 + \tau)\pi]$$

where  $\tau$  is the tariff rate and  $\pi$  is the exchange rate (the price of Country II's currency in terms of Country I's currency).

In Country II the price of imports is  $1/\pi$ , and as there is no tariff in this country its demand function for imports is:

$$(b) \quad u_2 = f_2(1/\pi)$$

The private expenditure of the residents of Country I for imports, measured in foreign currency, is  $u_1$ . But to this must be added what the government spends out of tariff income. The tariff income is equal to  $\tau u_1$ . Say a proportion  $k$  of this income is spent on imports. Total expenditure on imports, in foreign currency, in Country I therefore amounts to:

$$(c) \quad (1 + k\tau)f_1[(1 + \tau)\pi]$$

The total value of imports in Country II, in its currency, equals:

$$(d) \quad (1/\pi)f_2(1/\pi)$$

Metzler further assumes that trade between the two countries shall balance and the markets be cleared. This leads to the following equilibrium condition:

$$(e) \quad (1 + k\tau)f_1[(1 + \tau)\pi] = \frac{1}{\pi}f_2\left(\frac{1}{\pi}\right)$$

The internal price ratio in the first country is equal to  $(1 + \tau)\pi$ . Differentiating this ratio with respect to  $\tau$  using the equilibrium condition gives:<sup>4</sup>

<sup>4</sup> The two elasticities  $\eta_1$  and  $\eta_2$  are defined  $\eta_1 = -\pi(1 + \tau)f'_1/f_1$  and  $\eta_2 = (1/\pi)(f'_2/f_2)$ . Metzler says that  $\eta_1$  and  $\eta_2$  "are ordinary elasticities of demand for imports in I and II respectively." This is not the case. They are total elasticities for changes in the offer curves with respect to price. Hence they also depend on supply factors.

$$(f) \quad \frac{d(1 + \tau)\pi}{d\tau} = \frac{\pi}{\Delta} \left[ \frac{k(1 + \tau)}{1 + k\tau} + \eta_2 - 1 \right]$$

where  $\Delta = \eta_1 + \eta_2 - 1$ .

The only case in which the home market price ratio is not affected by a change in the tariff is when expression (f) is equal to zero. This happens when:

$$(g) \quad \eta_2 = 1 - k \left( \frac{1 + \tau}{1 + k\tau} \right)$$

If  $\eta_2$  is larger than the right-hand side of expression (g) the orthodox result will come about: an increase in the tariff will increase the price of the import good. Only if the opposite is the case will the relative price to importables fall because of the tariff. We might observe that the right-hand side of expression (g) can never be larger than one; if what Metzler terms the foreign demand elasticity for the first country's exports is larger than unity, the tariff-imposing country will always find that its imports become more expensive.

Metzler's analysis is of quite an implicit nature. Therefore we have to look more closely at the assumptions on which his analysis rests. First we might remark that he is not treating the general case, insofar as he starts from a situation with free trade and treats only the case with a tariff in one country and no tariff in the other country. Furthermore,  $f_1$  and  $f_2$ , as we have mentioned, are not pure demand functions, but analytic expressions for the offer curves; this implies that the elasticities connected with them,  $\eta_1$  and  $\eta_2$ , are not pure demand elasticities but also depend on supply factors.

A more peculiar, and as it seems, indefensible assumption is that he assumes the government to spend a certain amount,  $k$ , of the tariff income on imports irrespective of what prices are. This is connected with the fact that Metzler, like all other writers about tariffs, confuses two problems, that he treats two distinct problems as if they were one and the same: He tries at one and the same time to deal with the effects of a tariff and with a redistribution problem connected with the spending of the tariff income.<sup>5</sup>

There is, however, no reason to treat the two problems at the same time. The better approach to take if one wants to study the effects of tariffs is to isolate these effects. What we have done is to take two

<sup>5</sup> The notion that the effects of tariffs on prices depend on the way the tariff proceeds are spent goes back at least to Marshall [10]. It was also adopted by Lerner in his well-known paper [9] which is the starting point for the modern analysis of tariffs and trade. It also seems that it was the use of geometry as a tool of analysis that forced this mode of thought upon Lerner. This is, however, an example of a problem that hardly can be dealt with in a satisfactory way using geometric methods.

demand functions and let all income (including the tariff income) be spent according to these functions so that demand for the two goods is a function of national income and of relative prices. It should not be astonishing that, if one introduces a second problem and assumes that a specific income, the tariff income, gives rise to a specific expenditure pattern, the problem becomes more complicated. But it seems quite unnatural that one should insist that the effects of a tariff or a tax on the price structure should hinge upon some specific way in which the tariff or tax is spent, instead of simply assuming that the income generated by the tariff or tax is spent according to the same general principle as all other income.

The main result of our investigation with regard to prices is, therefore, that simpler and less ambiguous results can be reached under more general assumptions once one realizes the nature of the problem and does not introduce a redistribution problem into the question of how tariffs affect relative prices.

#### IV. *The Optimum Tariff*

Before we conclude this paper we should also deal with the important question of how tariffs affect the real incomes in the trading countries. This problem has to a certain extent been obscured by the fact that great stress has been laid upon its being a problem in welfare economics, a tradition inaugurated by Scitovsky [13]. We will not dwell upon its welfare aspects, as all that can be said from this point of view seems to be of a trivial nature. We simply define the optimum tariff as the tariff that maximizes a country's real national income.

The optimum tariff formula as it is stated in the literature is of the form  $t = E - 1$ , where  $t$  is the optimum tariff and  $E$  is the elasticity of the foreign reciprocal demand for exports.<sup>6</sup> What has to be observed, however, is that this is the formula for the optimum tariff only in a very specific sense. It is a formula that holds for any tariff, not only the optimal one.<sup>7</sup> But being a tautology, it also holds for the optimum tariff. It is almost entirely devoid of content.

We will now go on and in a straightforward way derive a formula for the optimum tariff that is more meaningful than the one so often referred to in the literature.

<sup>6</sup> This might be termed the basic formula. Others can be derived from it. For a derivation and discussion of it, cf. Bickerdicke [5], Graaff [7], and Johnson [8].

<sup>7</sup> One might add that the optimum tariff presupposes that the marginal rates of substitution in consumption and production at home are made equal to the marginal rate of transformation through foreign trade. This means, in geometric terms, that at the point where the optimum tariff formula holds, the community indifference curve of the tariff-imposing country should be tangent to the other country's offer curve. If this side-condition always is kept in mind, the formula becomes somewhat more meaningful.



The national income in Country I we defined as:

$$(1) \quad Y_1 = S_{1m} + PS_{1x} + t_1 C_{1m} = (1 + t_1) C_{1m} + PC_{1x}$$

The change in the real income, using Laspeyre's index, we define as:

$$(29) \quad dRI_1 = (1 + t_1) dC_{1m} + P dC_{1x}$$

The change in the national income is:

$$(30) \quad dY_1 = (1 + t_1) dC_{1m} + C_{1m} dt_1 + P dC_{1x} + C_{1x} dP$$

Using (14) we get the change in real income as:

$$(31) \quad dRI_1 = dX_1 + (S_{1x} - C_{1x}) dP$$

Using (22) and (24) we can express the change in the real income in the following explicit form:

$$(32) \quad dRI_1 = \frac{P}{\Delta} \left\{ [a_2(S_{1x} - C_{1x}) - t_1 b_2] \frac{\beta_1}{1 + t_1} dt_1 - [a_1(S_{1x} - C_{1x}) + t_1 b_1] \beta_2 dt_2 \right\}$$

where  $\Delta = a_1 b_2 + a_2 b_1$ .

At first we might remark that the effects on the first country's real income from an increase of the tariff in the second country is unambiguous: An increase in its tariff will always hurt the first country unless the first country is completely flexible so that either its demand or its supply elasticities tend to infinity, in which case neither its terms of trade nor its real income will be adversely affected by increases of its trading partner's tariff.

The effect of Country I's own tariff changes on its real income is more ambiguous. Here it may go either way; the real income might go up or it might fall because of an increase in the tariff. We are interested in finding the optimum tariff, i.e., the tariff that maximizes a country's real income. The real income of Country I has a maximum when expression (32) is equal to zero. Hence the optimum tariff,  $t_1^{\text{opt}}$ , is:

$$(33) \quad t_1^{\text{opt}} = \frac{a_2(S_{1x} - C_{1x})}{b_2}$$

Or if we write it in a more explicit way:

$$(34) \quad t_1^{\text{opt}} = \frac{\left(1 + t_2 \frac{\partial C_{2x}}{\partial Y_2}\right) (S_{1x} - C_{1x})}{(1 + t_2) \left[ P(1 + t_2) \frac{\partial S_{2m}}{\partial P} + \frac{\partial C_{2x}}{\partial P} + S_{2m} \frac{\partial C_{2x}}{\partial Y_2} \right]}$$

Formulae (33) and (34) give, in a somewhat implicit form, the optimum tariff for Country I. We might first observe that a large export share gives scope for a high optimum tariff. Otherwise the important factors stem from the second country. Again, we can see that the adaptability of the second country is of critical importance.<sup>8</sup> The marginal propensity to consume exportables in Country II is of a certain importance, but as it appears in both the numerator and the denominator its role is ambiguous. However, the supply elasticity of importables and the demand elasticity for exportables—the measures of adaptability of the economy, in other words—play an unambiguous role. The larger they are, the lower should Country I set its optimum tariff.

The economic significance of this result is easy to see. High values of these elasticities mean that the producers and consumers can easily adapt to changing circumstances. The producers can easily switch their factors of production from the export to the import competing line of production, and for the consumers the two goods are good substitutes. If both or any one of these conditions prevail, it does not pay for the country's trading partner to levy a high tariff on its imports. In the limiting case, where the values of the elasticities in question tend to infinity, the optimal policy for Country I will be free trade, as it will not be able to turn the terms of trade in its favor by a tariff but will only be limiting its trade at unchanged prices by levying a tariff on imports.

We will stop here. We have tried to deal with some of the basic problems in the theory of trade policy by a more explicit type of analysis than has usually been used in this area of economic analysis. We hope that we have been able thereby to demonstrate that simpler and clearer results can be derived and that a more thorough understanding of the interrelationships between the variables involved can be had.

There are, however, important problems that we have not touched on. As examples we might mention the effects of a tariff on income distribution in the case where the production function is not homogeneous of the first degree, and the question of the optimum tariff under retaliation. These and other problems of trade policy each merit a more thorough analysis and therefore fall outside the scope of a single article. We hope that we will be able to return to them on some future occasion.

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# ECONOMICS OF PRODUCTION FROM NATURAL RESOURCES

By VERNON L. SMITH\*

## I. *Introduction*

This paper attempts to provide a unified theory of production from natural resources. A single model of an industry is used to describe a dynamic process of recovery from such technologically diverse resources as fish, timber, petroleum, and minerals. Recovery from each of these resources is seen as a special case of a general model, depending upon whether the resource is replenishable, and on whether production exhibits significant externalities. A model of centralized management, with particular reference to "common property" resources, such as fisheries, under stationary conditions, is also discussed and compared with competitive recovery in the stationary state.

The paper builds directly upon, and has been much influenced by, the basic contributions of Gordon [6] and Scott [11] [12].

## II. *Environmental Technology*

The economy of man consumes two fundamental kinds of naturally occurring resources: (1) Replenishable resources, such as fish, timber, bison, and the whooping crane, and (2) nonreplenishable resources, such as petroleum, natural gas, and the products of mines. The second category is often called 'exhaustible resources,' which is something of a misnomer since both types of resources are capable of exhaustion. The American bison, once of value to the American economy, is such a case, as also were the native trout of Lake Michigan.<sup>1</sup> This particular dichotomy is important analytically in that the first category of resources is capable of regeneration, as man consumes a flow of the resource, while the second represents a fixed stock whose inventory can only be diminished over time.

For purposes of production analysis, one of the most important technological features of a replenishable commercial resource like a fish or

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<sup>1</sup> The two cases are different, however. Neither was exhausted in the physical sense, but in the economic sense. The biotic potential of fish is so large that complete extinction may be very difficult. With the Lake Michigan trout it was invasion by another predator—the sea lamprey—that destroyed the trout harvest. The lamprey have since been brought under control, and with restocking, the lake may again become an important fishery resource if pollution does not win the battle.

timber species is its law of growth. The growth characteristics of a species may be studied in terms of the growth in the number of members, and in the size of individual members [1], or in the aggregate mass of the species [8]. This paper will take a crude macrobiological approach, and deal only with variables which measure the aggregate masses of species. Such an approach is analogous to the aggregate production function hypothesis employed by economists in macroeconomics and growth theory.

The mass growth of a species will depend upon certain internal biological characteristics of the species, and on its environment, i.e., the abundance of food nutrients, and the existence and efficiency of other species which have predator or symbiotic relationships to the given species. We can think of any species to be harvested by man as subject to a "technological" law of growth governed by the ecological characteristics of the biosystem in which it resides [8].

In the simplest model of the technology of a replenishable resource, we consider a single species population with mass  $X$  in pounds, board feet, or other appropriate measure of quantity. The ecological balance between this species and its natural environment is postulated to give rise to a law of mass growth of the form

$$(2.1) \quad X \equiv \frac{dX}{dt} = f(X).$$

From the general ecological descriptions usually given for any species [8] as well as for fish [2, pp. 7-8] [4, p. 209] and timber [7] [9] resources, it is reasonable to assume that  $f(X)$  has the inverted "U" properties shown in Figure 1, i.e.,  $f(\underline{X}) = f(\bar{X}) = 0$ ,  $f'(X^0) = 0$ ,  $f''(X) < 0$ ,  $0 \leq X \leq \bar{X}$ , where  $\underline{X}$  and  $\bar{X}$  are the minimum and maximum self-sustaining populations, and  $X^0$  is the population producing the largest sustainable yield or net rate of growth. The yield function  $f(X)$  measures the net effect of the birth rate, the growth rate of individual members, and the death rate from natural causes, including predation from nonhuman sources. Populations smaller than  $\underline{X} \leq 0$ , are assumed not to be viable.

The most frequently postulated form for the yield function is the quadratic, giving

$$(2.1') \quad X = a_0 + X(a_1 - a_{11}X),$$

whose solution,  $X(t)$ , is the familiar and ubiquitous logistic law of growth [8, pp. 64-76].

In the natural state a replenishable resource, whose law of growth is governed by (2.1), will normally be expected to grow until the stable equilibrium  $X = \bar{X}$ ,  $\dot{X} = 0$  is reached. In such circumstances commercial

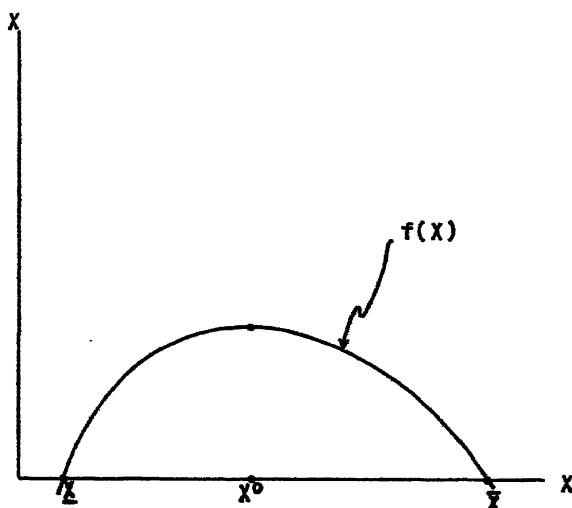


FIGURE 1

production from the resource by man will begin with these as initial conditions. (Note that  $\bar{X}$  is unstable.)

With the entry of man as a predator in the form of an extractive industry—commercial fishing, forest products, and so on—equation (2.1) must be modified to serve as a technological restriction on the activities of the industry. Throughout this paper, in order to sharpen the essential features of the theory and simplify the arithmetic we will assume that recovery from a given resource is effected by  $K$  homogeneous firms or units of capital, each producing an output rate,  $x$ . Total industry output is then  $Kx$ , where both  $K$  and  $x$  are, in general, variables. Hence, the required technological restriction might be written:<sup>2</sup>

$$(2.2) \quad \dot{X} = f(X) - Kx.$$

It is understood that  $x$ ,  $K$ ,  $X$  are each a function of time. Under our assumptions,  $K$  is both the number of firms (e.g., fishing boats) in the

<sup>2</sup> More generally, we should write  $\dot{X} = f(X, Kx)$ . In (2.2) we assume no interaction between the total harvest and the growth properties of the population mass, as likely will be the case if only restricted portions of the age distribution are harvested. Concerning my formulation of the constraint (2.2), and its use in the models to follow, the reader is urged to refer to [3], especially the mathematical appendix and the references cited there. Unfortunately, I suffered the impoverishment of not having acquired a copy of the important Crutchfield-Zellner book until after the present paper had been written. They work with the quadratic form of (2.2) in the context of a supply and demand industry model (and again in the treatment of the optimization problem of central management, both static and dynamic). Although my treatment was independent, and differs from theirs, the reader should view the present paper as essentially a generalization and explication of this earlier literature.

industry, and a measure of the real capital stock invested by the industry.

Turning now to nonreplenishable resources like petroleum, coal, iron ore, and other products of mines, we note that these form a simple special case of (2.2) in which  $f(X) \equiv 0$ , i.e., regeneration is assumed to be impossible so that the fixed stock declines at a time rate equal to aggregate industry output.

### III. Cost Behavior—The Technology of Recovery

The cost structure of the recovery process varies widely among the major commercial natural resources. Recovery cost in fishing, petroleum and natural gas is uniquely influenced by the "common property" character of these resources [6] [11]. No one has exclusively private rights in ocean fishing nor are such rights feasible to grant when commercial species are migrants. Similarly with crude oil extraction the reservoir's physical boundaries are often unknown, and even unknowable except at prohibitive cost. Such resources may therefore be shared by many private firms. An important consequence of this is that there may be direct and very significant external diseconomies in production, with an attending divergence of private and social optima.

On the other hand, forest and mineral resources are relatively divisible into independent productive units and to this extent are relatively free of significant production externalities.<sup>3</sup> Thus, of the two replenishable resources, fisheries and forests, it is assumed that the former shows significant external diseconomies of production while the latter does not. With the two nonreplenishable resources, petroleum and mining, again, the former is assumed to exhibit significant diseconomies, the latter is not.

In industries such as mining and lumbering, the extractive total cost function for the individual firm is assumed to be of the form,

$$(3.1) \quad C = \phi(x) + \# \quad C'(x) > 0, \quad C''(x) < 0,$$

where  $\phi(x)$  is total (fixed and variable) operating cost,<sup>4</sup> and  $\#$  is the

<sup>3</sup> The specialist will want to take this statement with a grain of salt. In forestry there are obvious externalities with regard to fire control (except remember that we are working with certainty models) and the spread of insects and disease. Also, in mining, one man's shaft may cause cave-ins or water encroachment on another mining property. A general disclaimer is in order: In a paper trying to emphasize the unity of production theory in the natural resource setting, one inevitably does a certain violence to the detailed facts, for there are indeed diverse elements to consider in the various cases of extraction. But the truth of unity, even if partial, is easily obscured by concentrating on more-or-less minor differentiating details.

<sup>4</sup> In (3.1) we somewhat oversimplify the view of mining and forestry production. In mining, cumulative output (or the unrecovered stock remaining) may affect cost; for this and other important considerations in mining see [13]. See footnote 11 for some relevant qualifications applying to appropriated forest resources.

normal profit or return on a unit of capital required to hold the unit (or firm) in the industry.

The most natural general hypothesis about total operating cost for the individual fisherman requires it to be an increasing function of the vessel's catch rate,  $x$ , but a decreasing function of fish population, i.e.,  $\phi = \phi(x, X)$ , with  $\phi_1 \equiv \partial\phi/\partial x > 0$ , and  $\phi_2 \equiv \partial\phi/\partial X < 0$ . The latter specification is implied if it is the case that when there are more fish of a given species they are easier to catch. On the other hand if increases in  $X$  cause no change in the density of stocks, as may be the case in some species, then it may be that  $\phi_2 \equiv 0$ . Externalities enter in an interesting and simple manner: *No individual competitive fisherman has control over population size as a private decision variable yet it enters as a parameter in each fisherman's cost function.* Externalities may also enter via crowding phenomena: If the fish population is highly concentrated, the efficiency of each boat may be lowered by congestion over the fishing grounds.<sup>5</sup> In general then the cost function may include  $K$ , and our most general cost hypothesis for the fishing firm is:

$$(3.2) \quad \begin{aligned} C &= \phi(x, X, K) + \pi, & C_1 &\equiv \partial C/\partial x > 0, \\ C_2 &\equiv \partial C/\partial X \leq 0, & C_3 &\equiv \partial C/\partial K \geq 0. \end{aligned}$$

When  $C_2 < 0$ , recovery cost exhibits resource *stock externalities*. When  $C_2 > 0$ , recovery cost exhibits *crowding externalities*. Each case represents an external diseconomy to the industry. Equation (3.2) will serve as the most general cost function with which we shall be concerned. It includes (3.1) as a special case. Another special case is crude oil production, since oil well drilling, development and operating costs are essentially independent of crude production in primary recovery fields (fields subject to natural drive forces).

#### IV. A Model of the Competitive Recovery of Natural Resources

We propose to characterize the competitive recovery process in any extractive industry by a system of three behavior equations describing the interactions of the resource, individual firms, and the industry. The term "industry" in the case of fishing and petroleum extraction will not necessarily refer to the entire industry, but to the collection of firms exploiting a given fishery or oil reservoir, since in these cases external interdependence is postulated.

<sup>5</sup> A good example is sport fishing for striped bass in San Francisco Bay. The stripers form schools to feed on schools of smaller food fish. The latter are driven to the surface, attempting to escape, and this attracts the gulls to feed. The fishing boats simply motor into the Bay looking for the mass of fighting gulls. The boats congregate around the gulls and then alternate with trolling passes through the concentrated school of stripers. On a busy holiday a considerable waiting line may develop.



The behavior equation for the resource has already been stated in (2.2), and describes the growth or decline of the stock as a function of stock size and industry output.

If we let  $\rho(Kx)$  be the total revenue rate from the sale of  $Kx$  units of the resource, then revenue per firm is  $\rho(Kx)/K$ , and, using (3.2) the most general form of the firm's pure or excess profit function is

$$(4.1) \quad \pi = \frac{\rho(Kx)}{K} - C(x, X, K).$$

It is assumed that each firm perceives this profit to vary only with its own output and this only because its private cost is variable with output. Thus price,  $\rho(Kx)/Kx$ , is perceived as a given constant, and  $C(x, X, K)$  is treated as a function only of the private control variable  $x$ . The behavior equation for firms is a perceived profit maximizing condition (price equals marginal cost), which serves to determine  $x$  as a function of capital and resource stocks depending on revenue, cost and externality conditions, viz

$$(4.2) \quad \frac{\rho(Kx)}{Kx} = \phi_1(x, X, K).$$

Some modification of the hypothesis (4.2) must be specified in the case of crude oil production where cost is substantially independent of output, and output depends primarily upon the characteristics of the field and its exploitation. In primary producing fields all crude oil is produced at the surface of a well by the action of one or more naturally occurring underground drives or pressures from edge water encroachment, a gas cap, or gas dissolved in the crude [10, pp. 391-93]. Both the rate of recovery and the cumulative recovery reduces the pressure level. So the output,  $x$ , of a given well can be regarded as a decreasing function of aggregate current output,  $Kx$ , and a decreasing function of cumulative output,  $\bar{X}-X$ , or<sup>\*</sup>

$$(4.2a) \quad x = g(Kx, X), \quad \frac{\partial g}{\partial (Kx)} = g_1 < 0, \quad \frac{\partial g}{\partial X} = g_2 > 0.$$

Finally, new firms (capital) are assumed to be attracted into the industry when  $\pi > 0$ , while producing firms are driven out of the industry when  $\pi < 0$ . Specifically, it is supposed that this flow of capital is proportional to pure profit, or

\* Alternatively we could write  $x = h(K, X)$ ,  $h_1 < 0$ ,  $h_2 > 0$ . With secondary (water or gas injection) and stripper (mechanical pumping) recovery fields, the cost function will be as in (3.2). We assume in the text that the ultimate cumulative recovery,  $\bar{X}-X$  is known and is independent of the production path. In fact, the total free-flow recovery may depend upon the extraction rate. See, for example, [5, pp. 91-92], and the references cited there.

$$(4.3) \quad \dot{K} = \delta \left[ \frac{\rho(Kx)}{K} - C(x, X, K) \right],$$

where  $\delta > 0$  is a behavioral constant for the industry.<sup>7</sup>

In summary, our behavioral equation system is

$$(I.1) \quad \dot{X} = f(X) - Kx,$$

$$(I.2) \quad \frac{\rho(Kx)}{Kx} = C_1(x, X, K), \quad \text{or} \quad x = g(Kx, X), \quad \text{for crude oil,}$$

$$(I.3) \quad \dot{K} = \delta \left[ \frac{\rho(Kx)}{K} - C(x, X, K) \right],$$

with  $f(X) \equiv 0$  for oil, gas and mineral stocks, and  $C_2 = C_3 \equiv 0$ , for mineral and timber resources.<sup>8</sup> It is further assumed that equation (I.2), whatever its particular form, always provides a unique  $x$  for every  $(X, K)$  pair (i.e., a mapping  $X, K \rightarrow x$ ). Then the system I provides two first-order differential equations in  $X$  and  $K$  of the form,

$$(II.1) \quad \dot{X} = F(X, K)$$

$$(II.2) \quad \dot{K} = I(X, K),$$

with initial conditions  $X(0)$  and  $K(0)$ . Where recovery requires specialized capital, exploitation begins with  $X(0) = \bar{X}$  and  $K(0) = 0$ , i.e., the resource is in static mass equilibrium with its environment, and an exploiting industry does not exist. If exploitation begins with a direct transfer of capital from other industries (e.g., haddock and cod fishing vessels shift to lobster), then  $K(0) > 0$ .

### V. The Dynamics of Competitive Recovery

#### A. General

Equation system II together with the initial conditions describe the velocity of a point in the "phase space"  $(X, K)$  i.e., the rates of increase

<sup>7</sup> In (4.3) we assume capital to be equally mobile out as well as into an industry, i.e., there is no problem of irreversibility. More generally we could write

$$\dot{K} = \begin{cases} \delta_1 x, & \text{if } x \geq 0 \\ \delta_2 x, & \text{if } x < 0. \end{cases}$$

We later assume  $\delta_2 = 0$  in the case of oil wells, which clearly cannot be reduced in quantity once drilled.

<sup>8</sup> Many variations on the particular forms of these behavior equations could be made. In place of (I.3) some variant of the accelerator hypothesis or an adaptive expectations hypothesis about investment could be introduced. In (I.2) any output adjustment hypothesis might be used in place of the classical—price equals marginal cost. If fishing is concentrated in a single season of the year (such as spawning time), then a difference equation expression of growth-harvest behavior could substitute for (I.1).

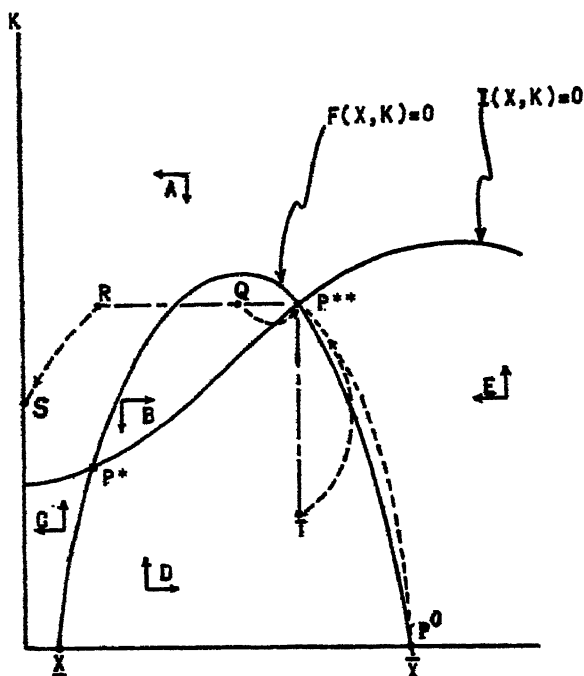


FIGURE 2

or decrease in (i) the resource stock, (ii) the level of capital investment of the industry.

A static equilibrium or singular point  $(X^*, K^*)$  is defined by the property that  $F(X^*, K^*)=0$ ,  $I(X^*, K^*)=0$ . There may be many such points. Two such singular points ( $P^*$  and  $P^{**}$ ) are illustrated in the phase diagram of Figure 2 for a replenishable resource. Points in the set defined by  $F(X, K)=0$  correspond to *equilibria between the resource mass and its environment*, while points in the set defined by  $I(X, K)=0$  correspond to *equilibria between the exploiting industry and alternative uses of capital in the economy as a whole*. Both equilibrium relations presuppose instantaneous output adjustment in accordance with firm profit maximization (I.2). In Figure 2 it is assumed that  $\partial F/\partial K < 0$ ; for any given resource stock, an increase (decrease) in the size of the industry will decrease (increase) the rate of growth of the resource, i.e., production exceeds the rate of replenishment. Also it is assumed that  $\partial I/\partial K < 0$ ; for any given resource stock, an increase (decrease) in the size of the industry lowers (raises) profit and reduces (increases) the flow of capital into the industry. Conditions for the validity of these two assumptions are stated in the appendix. The assumptions apply only to the illustration in Figure 2, and not to the model in general.

Under these assumptions the nonnegative quadrant is partitioned into five regions by the  $F$  and  $I$  curves. In region A, above both curves, both the industry and the resource stock will decline. In region D, below both curves, both the industry and the resource stock will grow. In regions B, C and E the remaining combinations of growth in  $K$  and  $X$  occur as shown. The perpendicular arrows in each region indicate in the usual way, the directions of motion along a development path in phase space. If initially the resource population is at  $\bar{X}$ , and  $K=0$ , then (by hypothesis)  $\dot{K}>0$  and capital flows into the new extractive industry reducing the resource mass along the path from  $P^0$  to  $P^{**}$  as shown.  $P^{**}$  is an equilibrium point for the conditions postulated in the illustration. At  $P^{**}$  the industry is in equilibrium with the economy, and the species mass is in ecological equilibrium (total recruitment of new mass equals the harvest rate). The illustration shows  $P^{**}$  to be locally, but not globally stable. Thus, suppose having reached  $P^{**}$ , there is a sudden reduction in  $X$  from natural causes—such as a disease which wipes out the susceptible portion of the species and then disappears. The system is then shifted to the point  $Q$  or  $R$ . At  $Q$  firms suffer losses, and capital starts to leave the industry, while the natural productivity of the resource is increased to a level above harvesting by the industry. The resource mass rises, and the industry declines until the state of the system crosses into region D where the industry is once more profitable. Capital now flows back into the industry, and the resource mass continues to grow until balanced by the industry harvest at  $P^{**}$ . If the catastrophe is large, and the system shifts to a point such as  $R$  in region A, the resource mass declines, and the yield of the species is lowered. As a result the harvest exceeds the yield, the resource stock falls, and the industry declines until both may be put out of business at  $S$ .

The qualitative properties of virtually any conceivable pattern of resource exploitation can be depicted by a phase diagram similar to the illustration of Figure 2. Invasion of the resource domain by a new parasite or predator, which becomes a permanent aspect of the environment, can be represented by a downward shift of the  $F$  function.  $F$  may fall below  $I$  so that the invading parasite or predator together with the industrial harvest wipes out the resource and thence the industry. Such was the course of events when the lamprey invaded Lake Michigan destroying both the lake trout and the lake's fishing industry.

From the above illustration it is clear that commercial production from a replenishable resource need not in time destroy the resource. Exploitation by man *may* disrupt a delicate balance which destroys a resource. But the existence of external diseconomies (though it lead to non-Pareto efficient production states) does provide a built-in mechanism tending to resist annihilation of the resource: harvesting depletes

the stock, costs rise and, *ceteris paribus*, discourages harvesting, with the possibility if not a guarantee of an equilibrium such as  $P^{**}$  in Figure 2.

We turn next to an analysis of various special applications and examples of the general model.

### B. Selling Price Constant: The Fishery

Much of the more systematic literature on resource economics has been concerned with the implications of competitive recovery under conditions of constant price, not only to the individual firm, but also to the individual resource deposit, fishing ground, and so on [2] [6]. It is therefore of some interest to explore the implications of the model for this case.

With selling price,  $p \equiv \rho(Kx)/Kx \equiv \text{constant}$ , system I becomes,

$$(IA.1) \quad \dot{X} = f(X) - Kx$$

$$(IA.2) \quad p = C_1(x, X, K)$$

$$(IA.3) \quad \dot{K} = \delta[pK - C(x, X, K)].$$

Writing total differentials of equations (IA.2) and (IA.3), and solving for  $dK/dX$ , we get

$$(5.1) \quad \left. \frac{dK}{dX} \right|_{\dot{K}=0} = \frac{-C_2}{C_3},$$

which is the slope of the  $I(X, K)=0$  function in system II. Hence, if  $C_2 < 0$ ,  $C_3 > 0$ , i.e., we have external diseconomies from both fish shortage and crowding by vessels, then  $I(X, K)=0$  defines  $K$  as an increasing function of  $X$ . Every reduction in the fish mass will increase costs, and force some fishermen out of the industry until a new normal-return equilibrium is established.

In like manner, differentiating (IA.1) and (IA.2), with  $\dot{X}=0$ , we get

$$(5.2) \quad \left. \frac{dK}{dX} \right|_{\dot{X}=0} = \frac{KC_{12} + C_{11}f'}{\pi C_{11} - KC_{13}}$$

for the slope of  $F(X, K)=0$ . Since  $f' \leq 0$ , if  $C_{12} < 0$ ,  $C_{11} > 0$ ,  $C_{13} > 0$ , the sign of this derivative is not determined on the basis of qualitative considerations alone, and may change in the phase space.

Figures 3-5 illustrate some possible effects of different externality assumptions on industry equilibrium,  $I(X, K)=0$ , and several possible solution paths in phase space. In each case it is assumed that

$$\left. \frac{dK}{dX} \right|_{\dot{X}=0}$$

is positive below some value of  $X$ , and negative above that value.

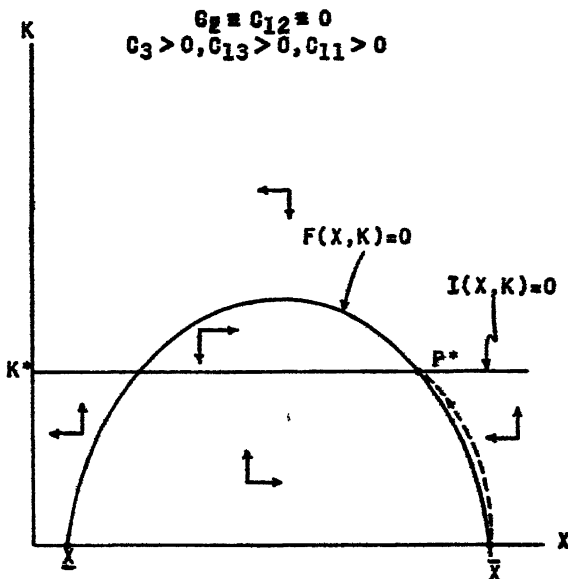


FIGURE 3a

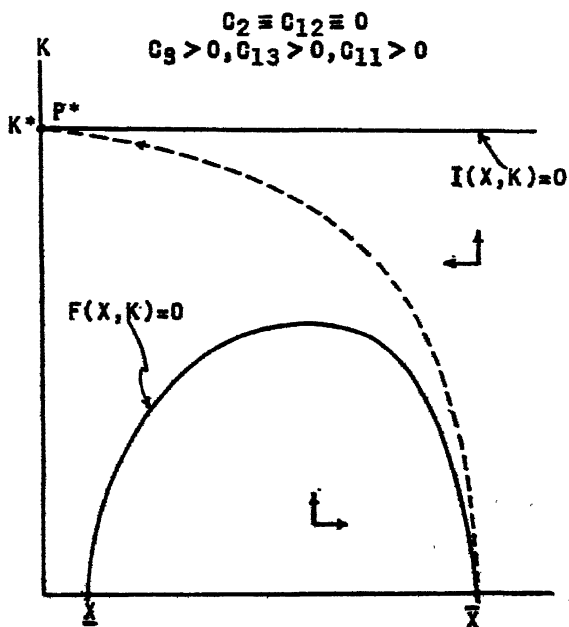


FIGURE 3b

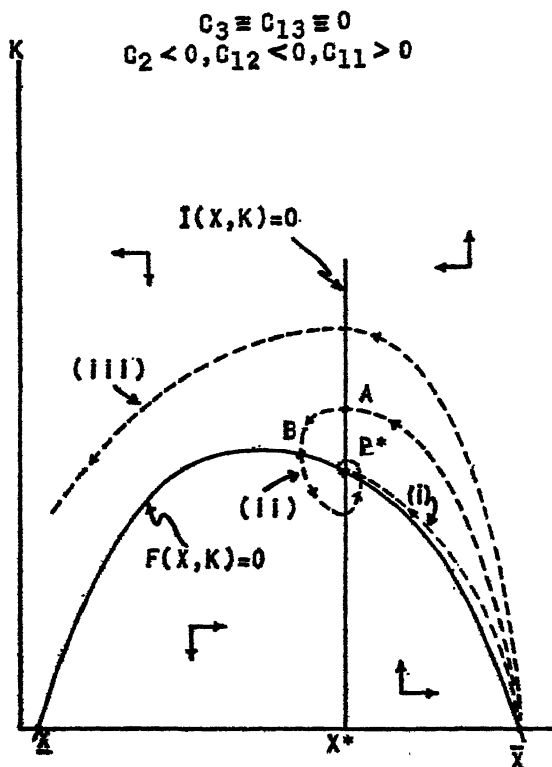


FIGURE 4a

In Figures 3a and 3b, with no resource stock externalities, but with crowding externalities, industry equilibrium occurs at  $K^*$  independent of  $X$ . A possible path to the equilibrium at  $P^*$  is shown. In Figure 3b the resource is so profitable that it is wiped out before crowding externalities limit the industry's growth.

In Figures 4a-c, we assume stock externalities to be significant but no crowding externalities. In contrast to the previous case, industry equilibrium is determined at  $X^*$  independent of  $K$ . Figure 4a shows three possible paths to equilibrium: (i) a direct path to  $P^*$  with monotone growth in the industry and monotone decline in the resource stock to the self-sustaining level  $X^*$ ; (ii) a cyclical path in which firms respond so quickly to pure profits that when industry equilibrium is reached at  $A$  the harvest exceeds the yield of the stock causing the stock to continue falling. But with the stock continuing to fall costs rise, losses are incurred, and firms are forced out of the industry. The declining harvest eventually provides equilibrium of the resource stock, at  $B$  but the industry is declining. And so on in a convergent cyclical path

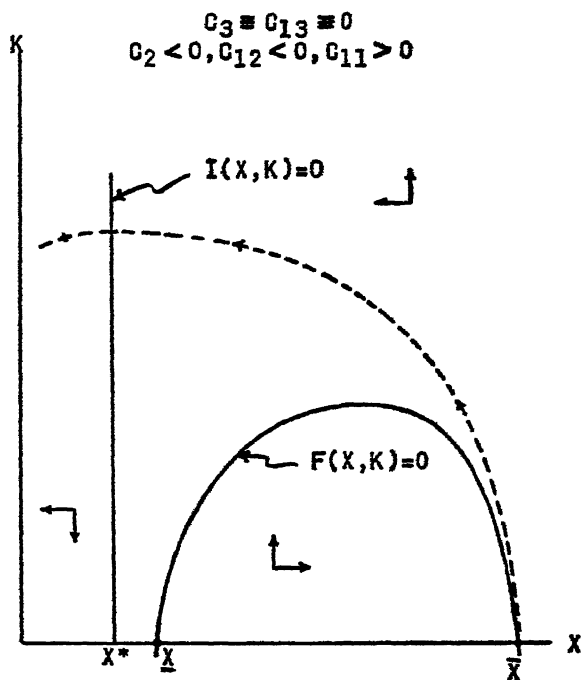


FIGURE 4b

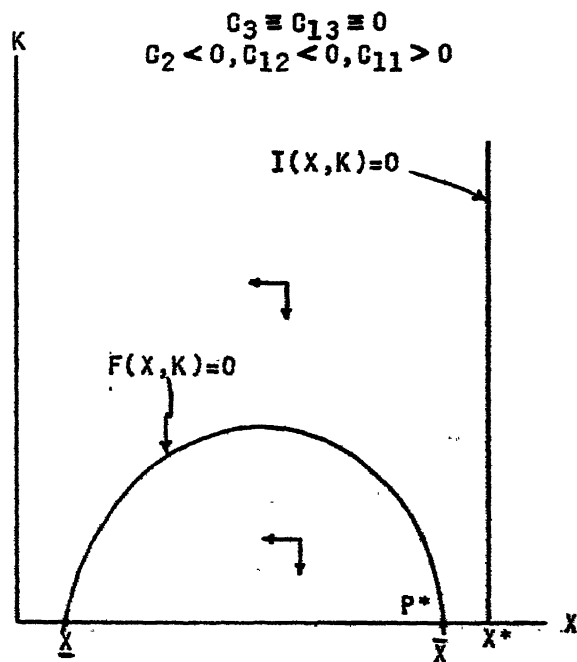
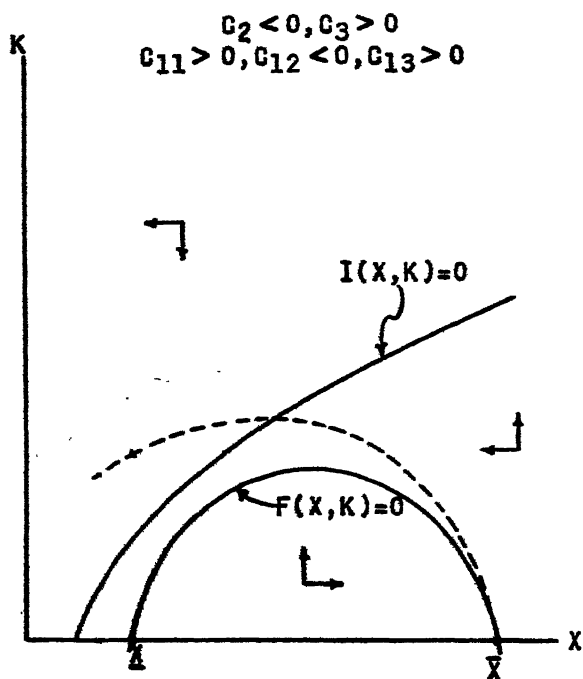
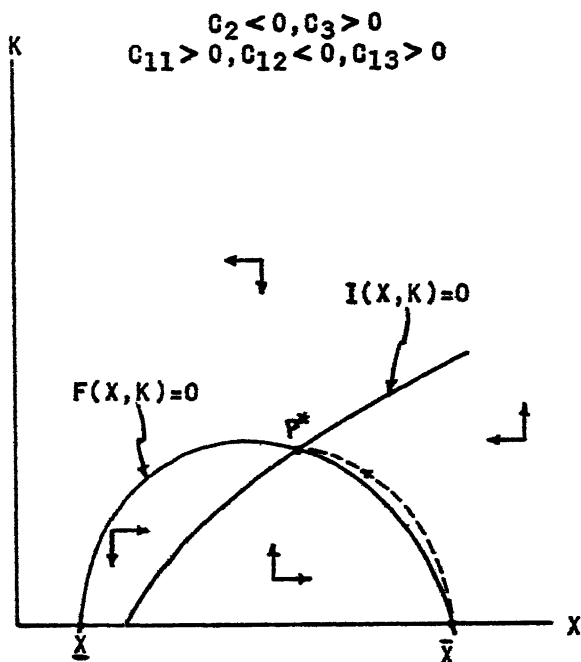


FIGURE 4c





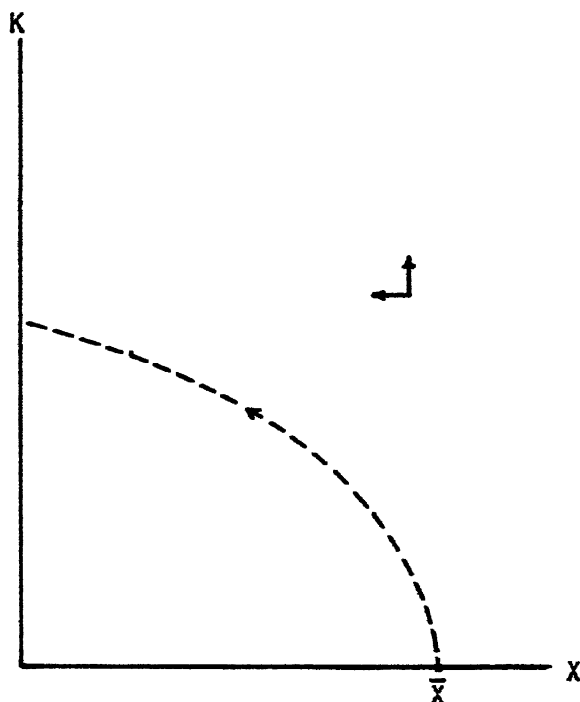


FIGURE 6

with capital flowing in and out in response to cost changes induced by the decline and rise of the stock level; (iii) a path in which the entry speed of new firms is so rapid, and resource stock externalities such, that the stock is depleted before capital outflow due to losses can bring the harvest rate below the yield. Figure 4b illustrates the polar case in which the harvest is so profitable that the resource is sure to be depleted, while 4c shows the opposite pole where it does not pay to harvest any of the resource. Figures 5a and 5b illustrate the more general case in which both kinds of externalities are present.

### C. Mining

We have assumed mining to be the prototype of a nonreplenishable resource with insignificant externalities due to resource scarcity and crowding. Under these assumptions  $f(X) \equiv 0$ , and  $C_2 \equiv C_3 \equiv 0$  in system (IA). Hence, if recovery is profitable,  $x = x^0$  is determined by equation (IA.2), and  $\dot{K} = \delta[p x^0 - C(x^0)] > 0$ . Capital flows into the resource at a constant rate, and the depletion rate of the resource is  $\dot{X} = -K x^0$ . Figure 6 illustrates the equilibrium path to depletion.

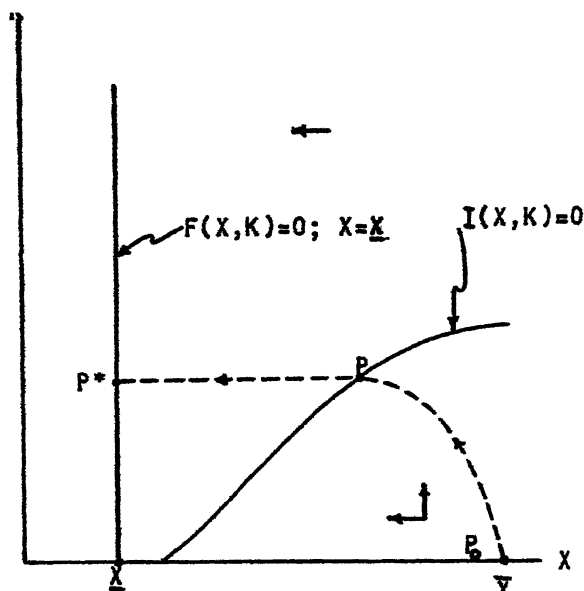


FIGURE 7

#### D. Petroleum

The dynamics of competitive petroleum recovery is slightly more complicated due to externalities. The fixed price equation system is:

$$(IB.1) \quad \dot{X} = -Kx$$

$$(IB.2) \quad x = g(Kx, X), \quad g_1 < 0, \quad g_2 > 0.$$

$$(IB.3) \quad \dot{K} = \delta[p_x - C_0], \quad \delta = 0, \quad \text{if } p_x < C_0, \quad \delta > 0 \text{ otherwise.}$$

In equation (IB.3) we impose the condition that  $\dot{K} \geq 0$ ; wells once drilled cannot "flow out" of the resource. With all costs fixed, production continues as long as the natural drive forces persist.

Observe first that if it pays to drill any wells at all, then at some point  $K > 0$ , and, by (IB.3),  $K$  can never fall. Hence,  $\dot{X} = 0$  in (IB.1) if and only if  $x = 0$ , i.e., the resource is not in equilibrium until well output is zero. The resource equilibrium set, defined by  $F(X, K) = 0$  in system II is here defined by the condition  $g(0, \bar{X}) = 0$ , where  $X = \bar{X}$  is the depleted level of the oil reservoir (Figure 7). That is, the primary or free-flow stage of recovery ends at  $X = \bar{X}$ , when  $x = 0$ . Similarly, equilibrium in the industry, defined by the function  $I(X, K) = 0$  in system II, is here defined by (IB.2) and (IB.3) with  $\dot{K} = 0$ , or  $C_0/p = g(KC_0/p, X)$ . Writing the total differential of this last equation and solving for

$dK/dX$ , gives the slope of  $I(X, K)=0$ :

$$(5.3) \quad \frac{dK}{dX} \Big|_{\dot{K}=0} = - \frac{p g_1}{C_0 g_2} > 0.$$

Hence, the equilibrium size of the industry is a strictly increasing function of the size of the untapped oil reservoir,  $X$ .

The phase diagram for the competitive exploitation of an oil reservoir will therefore appear as in Figure 7. Initially, the system is at  $P_0$  ( $\dot{K}=0$ ,  $X=\bar{X}$ ), where  $\bar{X}$  is the initial level of the oil reservoir stock. Since  $I(X, K)=0$  is shown above  $P_0$ , it pays for drilling firms to exploit the resource. Hence  $\dot{K} > 0$ ,  $\dot{X} = -Kx < 0$ , and the state of the system moves along some path to a point  $P$  on  $I(X, K)=0$  as shown. Thereafter,  $\dot{K}=0$ , but the stock decline,  $\dot{X} = -Kx < 0$ , proceeds apace until  $x=0$  at  $P^*$ . The reservoir is depleted, the wells capped and abandoned (unless pumping is profitable).

#### E. Timber

Timber resources are replenishable, but we assume no significant production externalities either from population scarcity or crowding by producers. These assumptions may also apply to exhausted historical species like the whooping crane and the American bison (if both species were so easily harvested that cost was not influenced by population mass). System (IA) becomes:

$$(IC.1) \quad \dot{X} = f(X) - Kx$$

$$(IC.2) \quad \dot{p} = C_1(x)$$

$$(C.3) \quad \dot{K} = \delta[p x - C(x)]$$

(IC.2) determines  $x^0$ . If  $p x^0 - C(x^0) > 0$  harvesting is profitable, and firms enter the resource. Eventually the entire stand, and all new growth during the exploitation period is exhausted, as illustrated in Figure 8. Such is the demise of an unappropriated replenishable resource which does not exhibit external diseconomies to the industry.

### VI. Centralized Fishery Management: Sole Ownership and Regulated Competition

In the literature of fishery economics the important papers by H. Gordon [6] and A. Scott [11] have emphasized the advantages of unified management or "sole ownership" of the fishing ground as distinct from the unregulated decentralized exploitation of the resource. Sole ownership permits the social costs of production to be borne privately with the result that the private producer has the incentive to manage the

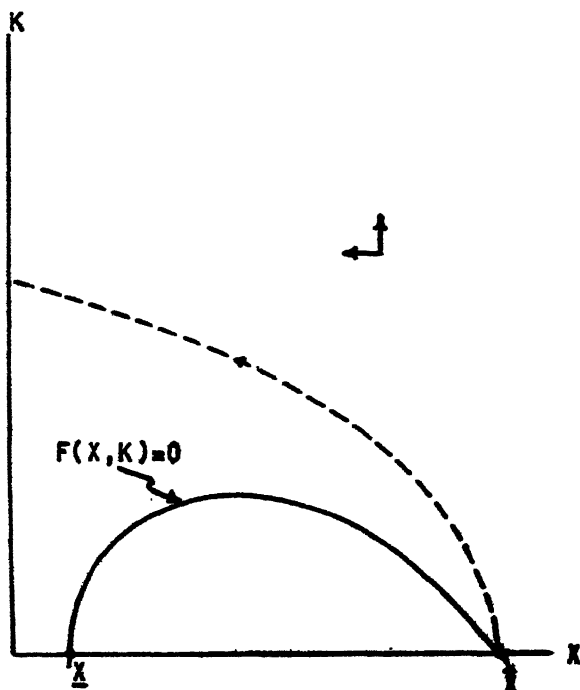


FIGURE 8

resource in the interests of society as well as his own. To see how these results follow using the competitive model of this paper, we must develop the contrasting model of centralized management.

We assume with Gordon and Scott that there are many fishing grounds so that centralizing the ownership (or right of access) of any one does not introduce monopoly elements.<sup>9</sup> We continue to assume steady-state equilibrium,  $\dot{X}=0$ . Under centralized management  $x$ ,  $X$  and  $K$  will all be decision variables subject to control, in the interest of profit, by the sole owner. His profit function will be  $\pi = pKx - KC(x, X, K)$  which is to be maximized with respect to  $(x, X, K)$ , subject to  $\dot{X} = f(X) - Kx = 0$ . The Lagrangean is thus

$$\Psi = pKx - KC(x, X, K) + \lambda[f(X) - Kx],$$

and the first order conditions for an interior maximum can be written:

<sup>9</sup> This assumption is not essential, but keeps the arithmetic simpler. If sole ownership leads also to monopoly, we might still study the efficiency implication of the former uncontaminated by monopoly effects by imposing as an *additional constraint* upon the sole owner the price control condition  $p(Kx) \leq K\bar{p}$ , where  $\bar{p}$  is the maximum selling price permitted.

$$\frac{\partial \Psi}{\partial x} = pK - KC_1 - \lambda K = 0$$

$$\frac{\partial \Psi}{\partial X} = -KC_2 + \lambda f'(X) = 0$$

$$\frac{\partial \Psi}{\partial K} = px - KC_3 - C - \lambda x = 0$$

An interior maximum must therefore satisfy the system

$$(6.1) \quad f(X) = Kx$$

$$(6.2) \quad p - C_1 = \lambda$$

$$(6.3) \quad p - \frac{C}{x} - \frac{KC_3}{x} = \lambda$$

$$(6.4) \quad \lambda = \frac{KC_2}{f'}$$

By way of interpreting these conditions, note that total fleet catch,  $Kx$ , can be increased either by increasing catch per vessel,  $x$ , or by expanding the fleet,  $K$ . The Lagrange multiplier  $\lambda$ , in this instance, is the marginal profitability of the total fleet catch (or yield of the fish mass). Condition (6.2) requires the marginal profitability of increasing catch by intensive use of the fleet (i.e., by increasing  $x$ ) to be equal to the marginal profitability of total fleet catch,  $\lambda$ . Condition (6.3) requires the marginal profitability of the catch from fleet expansion to equal  $\lambda$ . Thus (6.2) and (6.3) state that profitability at the intensive and extensive capital margins must be equal. Finally,  $KC_2/f'$  is the marginal external or social cost of the fleet catch. An increase in catch tending to lower the fish mass contributes fishing costs external to the individual boats. Since  $C_2$  is negative while  $f'$  may be negative or positive, the question arises as to whether a maximum can occur with negative marginal social cost. It is easy to prove that a global maximum cannot occur at an  $X^*$  such that  $f'(X^*) > 0$ . Suppose we have equations (6.1)–(6.4) satisfied by a point  $(x^*, X^*, K^*)$ , with  $f'(X^*) > 0$ . Then we know from the properties of  $f(X)$ , that there is an  $X^{**} > X^*$  such that  $f'(X^{**}) < 0$ , and  $K^*x^* = f(X^*) = f(X^{**})$ . But since  $C_2 < 0$ ,  $C(x^*, X^*, K^*) > C(x^*, X^{**}, K^*)$ . It follows that the point  $(x^*, X^{**}, K^*)$  satisfies the constraint, and yields a greater profit. Hence,  $f' < 0$  and  $KC_2/f' > 0$  in (6.4).<sup>10</sup>

Under competitive harvesting  $KC_2/f'$  is a social cost which does not

<sup>10</sup> Imposing a global maximum criterion is essential here since a "solution" with  $X = X^*$  may not only satisfy (6.1)–(6.4) but also the corresponding second-order conditions for a relative interior maximum.

affect firm behavior; but this cost is "privatized" when property rights are vested in a central manager-owner who adjusts his operations according to (6.2) and (6.4) to account for these social costs. Similarly will the central manager adjust for the effects of boat crowding over the fishing ground. Thus in (6.3), multiplying through by  $x$ ,  $px$  is the gross marginal revenue from an additional vessel,  $C$  is the long-run direct internal cost, while  $KC_3 + \lambda x$  is the long-run marginal external social cost of operating an additional vessel. An addition to the fleet produces external crowding cost at the rate  $KC_3$ , and external fish scarcity cost at the rate  $\lambda x$ .

For the sole owner when  $C_2 \equiv C_3 \equiv 0$ , we have the conditions which could be postulated to apply to *appropriated* timber resources. With the appropriation of forest property rights comes an incentive to "conserve," and the forest will not be wiped out as in our previous model. The first order conditions become:

$$\begin{aligned} f(X) &= Kx \\ p - C_1 &= \lambda \\ C_1 &= \frac{C}{x} \\ f'(X) &= 0 \end{aligned}$$

We see that only in the absence of resource stock externalities is it optimal to maintain the resource stock at the level which maximizes recruitment or sustainable yield, where  $f'(X^0) = 0$ .<sup>11</sup>

<sup>11</sup> This result could be misleading in that it conflicts with some of the forestry economics literature [7], which contains valid arguments against the objective of maximizing sustainable yield. I do not argue that forest managers "should" maximize sustainable yield. This is simply a result of the assumptions made above, and I do not have any commitment to the assumptions. In a model of maximization over time and/or in a model in which forest husbanding costs are introduced and assumed to depend upon forest stock, sustainable yield will no longer be maximized in an optimal program.

With maximization over time, the discounting process will associate interest cost with  $X$  because forest growth depends upon  $X$ . Even in a static model, if husbanding costs depend upon  $X$ , we must then write cost as  $C(x, X)$ , not because of externalities measured by  $X$ , as in fishing, but because appropriation brings the incentive to incur costs of cultivating the stock. In such a case, the first order conditions for the sole forest owner are:

$$\begin{aligned} f(X) &= Kx \\ p - C_1 &= \lambda \\ C_1 &= \frac{C}{x} \\ \lambda &= \frac{KC_2}{f'} \end{aligned}$$

However, in contrast with the fishing model,  $C_2 > 0$  (husbanding costs increase with the stock). Consequently, for a global maximum,  $f' > 0$ , and the optimally managed stock is lower than the stock corresponding to maximum sustainable yield.

By comparing (6.1)–(6.4) with the system (IA.1)–(IA.3), where  $\dot{K} = \dot{X} = 0$  in the latter, we contrast sole ownership with decentralized competitive recovery in the stationary state. The two systems differ only in that the sole owner perceives a *unit catch* cost,  $\lambda = KC_2/f'$ , and an *annual boat* cost  $KC_2 + \lambda x$ , which is not incurred by the decentralized competitive fisherman. Theoretically, then, the problem of regulating competitive recovery can be stated as one of imposing these unperceived social costs on the industry. The partial equilibrium solution to the regulation problem is to levy an extraction fee  $U = KC_2/f'$  per unit of catch unloaded at the wharf, plus an annual license fee  $L = KC_2$  on each fishing vessel.<sup>12</sup> As a consequence profit after taxes to each competitive fishing vessel is

$$\pi^* = px - C(x, X, K) - L - Ux.$$

If each fisherman chooses  $x$  to maximize  $\pi^*$ , and fishermen, with their boats, enter the industry as long as  $\pi^* > 0$ , the equilibrium conditions become

$$(6.5) \quad f(X) = Kx$$

$$(6.6) \quad p - C_1 = U$$

$$(6.7) \quad p - \frac{C}{x} - \frac{L}{x} = U$$

This system is identical with (6.1)–(6.4) for centralized management provided only that the regulating authorities are omniscient enough to fix  $U = \lambda = KC_2/f'$ , and  $L = KC_2$  at optimizing values satisfying (6.1)–(6.4).<sup>13</sup>

#### APPENDIX

In this appendix we consider some qualitative properties of the system (I.1)–(I.3) or (II.1)–(II.2), particularly as the system is illustrated in Figure 2.

The following qualitative restrictions on the cost function will be assumed:  $C_1 > 0$ ,  $C_2 < 0$ ,  $C_3 \geq 0$ ,  $C_{11} > 0$ ,  $C_{12} < 0$ ,  $C_{13} \geq 0$ . Also it is assumed that

<sup>12</sup> Regulatory devices other than taxes or fees could, of course, be used, such as direct controls on entry [4, p. 214]. But the resulting large rents may induce investment in gear improvement, more intense fishing, and other operating changes which invite more detailed controls. In practice, such direct controls have almost invariably taken the form of devices that reduce efficiency [4, p. 207].

<sup>13</sup> There are, of course, other important aspects of the problem of optimal fishery regulation. Of particular importance is the problem of regulating mesh size as a means of selective harvesting [1, 14]. The idea behind mesh control is to limit the harvest to the older, and larger, members of the species whose growth rates are considerably slower than those of the younger members. The present paper has also omitted any explicit analysis of the problem of interspecies equilibrium where more than a single species have commercial value. There is also the interesting problem of optimization over time for centrally managed recovery—a problem in Pontryagin control theory. Such extensions will be treated in separate papers.



the demand (or average revenue) function,  $\rho(Kx)/Kx$ , is monotone decreasing in  $Kx$ . Hence  $\rho' < \rho/Kx$ , and therefore from (I.2)  $\rho' < C_1$ .

We first examine the slopes in phase space along the equilibrium sets  $\dot{K} = F(X, K) = 0$  and  $\dot{K} = I(X, K) = 0$ . Setting  $\dot{K} = 0$ , differentiating the equations (I.1) and (I.2), and eliminating  $dx/dX$  by substitution, we solve for

$$(A.1) \quad \frac{dK}{dX} \Big|_{\dot{K}=0} = \frac{(C_1 + xC_{11} - \rho')f' + KxC_{12}}{x(xC_{11} - KC_{13})}$$

If  $C_{13} = 0$ , or if  $KC_{13} < xC_{11}$ , the denominator of this expression is positive. Since  $C_{12} < 0$ ,  $\rho' < C_1$ , with  $f' \geq 0$  according as  $X \leq X^0$  it follows that

$$\frac{dK}{dX} \Big|_{\dot{K}=0}$$

is either (i) always negative or (ii) nonnegative for all  $X \leq \hat{X} < X^0$ , and negative for  $X > \hat{X}$ . The curve for  $F(X, K) = 0$  in Figure 2 illustrates this second case.

Setting  $\dot{K} = 0$ , differentiating (I.2) and (I.3), and eliminating  $dx/dX$  by substitution, we solve for

$$(A.2) \quad \frac{dK}{dX} \Big|_{\dot{K}=0} = \frac{KxC_2C_{11} + K(\rho' - C_1)(xC_{12} - C_2)}{(\rho' - C_1)KC_3 + (\rho' - C_1)x(xC_{11} - KC_{13}) - KxC_{11}C_3}$$

If  $C_{13} = 0$ , or  $KC_{13} < xC_{11}$ , the denominator in (A.2) is negative. If  $xC_{12} - C_2 > 0$ , the numerator is negative, and

$$\frac{dK}{dX} \Big|_{\dot{K}=0}$$

is positive, but if  $xC_{12} - C_2 < 0$ ,

$$\frac{dK}{dX} \Big|_{\dot{K}=0}$$

may change sign. The curve for  $I(X, K) = 0$  in Figure 2 illustrates a case in which

$$\frac{dK}{dX} \Big|_{\dot{K}=0}$$

changes signs once, from positive to negative as  $X$  increases from zero. From (A.2) it is clear that many other configurations are compatible with the stated qualitative restrictions.

Now consider the directions of motion in phase space of points in the partitions A-E of Figure 2. Differentiating (II.1), or (I.1) and (I.2), with  $X$  fixed, gives

$$(A.3) \quad \frac{\partial \dot{X}}{\partial K} = F_K = \frac{x(KC_{13} - xC_{11})}{C_1 + xC_{11} - \rho'}$$

The denominator is strictly positive. If  $C_{13}=0$ , or  $KC_{13}<xC_{11}$  then  $F_K<0$ . It follows that  $\dot{X}<0$  for all points above the  $F(X, K)=0$  curve in Figure 2, and  $\dot{X}>0$  for all points below this curve.

Differentiating (II. 2), or (I.2) and (I.3), with  $X$  fixed, gives

$$(A.4) \quad \frac{\partial \dot{K}}{\partial K} = I_K = -\frac{\delta x}{K} \left\{ \frac{(\rho' - C_1)(KC_{13} - xC_{11})}{C_1 + xC_{11} - \rho'} + \frac{KC_3}{x} \right\}$$

Repeating the previous restrictions on  $C_{13}$  and  $C_{11}$ , we see that  $I_K<0$ . It follows that  $\dot{K}<0$  for all points above  $I(X, K)=0$  in Figure 2 and  $\dot{K}>0$  for all points below this curve.

In the special case in which price is constant to the exploited resource  $p \equiv p/Kx$ ,  $\rho' = p = C_1$ , and (A.1) reduces to (5.2) in the text, while (A.2) becomes (5.1).

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## THE INFLUENCE OF OWNERSHIP AND CONTROL ON PROFIT RATES

By DAVID R. KAMERSCHEN\*

In a recent article in this *Review* [8], Robert J. Lerner made an invaluable study of the extent of management control among the 200 largest nonfinancial corporations in 1963 and compared his findings with the 1929 Berle and Means study [4]. He concluded that "it would appear that Berle and Means in 1929 were observing a "managerial revolution" in process. Now, 30 years later, that revolution seems close to complete, at least within the range of the 200 largest nonfinancial corporations" [8, pp. 786-87].

This is an important finding. What I should like to do in the present study is to extend Lerner's analysis and determine whether the extent of management control exerts an important influence on the rates of return in these firms. I submit that it generally does not, and support for this contention forms the primary subject matter of this paper. In addition, the variables that are important in "explaining" inter-firm profit rates are demonstrated empirically. In other words, I accept Stigler's results [13] on profit rates where relevant, and the purpose of this article is to see whether the Lerner results make any significant difference or not. (To be sure Stigler's results are not quite comparable to ours since he works with industry data while this study uses firm data.)

### I. The Sample

Lerner obtained data for the 200 largest nonfinancial corporations (1963) from annual reports, proxy statements, *Fortune* [15, 16] and *Moody's* [18, 19, 20]. This list is "composed of firms primarily engaged in manufacturing, mining, merchandising, transportation, and electric,

\* The author is an associate professor of economics at the University of Missouri, Columbia. He is indebted to his colleagues, especially Professors Orace E. Johnson and Richard L. Wallace, for critical comments; also to Howard R. Watts, Supervisor of Statistics, Computer Research Center, University of Missouri, for computational assistance and to Michael L. Girou, for research assistance. Professors Floyd K. Harmston and Robert W. Paterson facilitated the research effort in a number of ways. In addition an anonymous referee made some invaluable suggestions both as to content and wording. Robert J. Lerner was also very helpful in providing the author with the unpublished Appendix to his article containing the name of each of the 200 largest nonfinancial corporations in 1963 "together with its size and rank in assets, its type of control, immediate and ultimate, in both 1963 and 1929, and the source and basis of its classification in 1963" [8, p. 780]. Finally, the author is indebted to Professor Marshall M. Hall for a copy of his and Professor L. W. Weiss' unpublished manuscript [7]. Research on this paper was supported in part by a Summer Faculty Fellowship from the Business and Public Administration Research Center at the University of Missouri. None of these persons or organizations is of course responsible for the conclusions or any errors which may still remain.

gas, and pipeline utilities. Banks, insurance companies, and investment companies are excluded" [8, p. 778]. Size is measured in terms of book assets although this overstates the relative size of transportation and utility companies. He retained the Berle and Means distinction between "ultimate control" and "immediate control"<sup>1</sup> and their classification of firms according to the following five types of corporate control (1) privately owned, (2) controlled through the ownership of a majority of the voting stock, (3) controlled through the ownership of a dominant minority of the voting stock, (4) controlled by means of a legal device, and (5) management-controlled.<sup>2</sup> The most significant finding of his study was that management control had substantially increased in each of the major industrial groups [industrials ( $N=117$ ), public utilities ( $N=59$ ), and transportation ( $N=24$ ) companies in 1963] since 1929.<sup>3</sup>

To determine whether the type of ownership and control investigated by Lerner influences the profit rate, the following explanatory variables are employed along with the dependent variable, the rate of return after tax on year-end equity ("invested capital").

## II. The Variables

In the empirical results variable  $X_1$  is always used as the regressor and variables  $X_2$ - $X_5$  as the regressands. In other words, an attempt will be made to ascertain the proximate determinants of the profit rates. Although subject to controversy, the rate of return after tax on year-end equity ("invested capital") as reported in *Fortune* is used to measure the profit rate. If managers act in the best interests of owners, they will try to maximize this rate of return. In perfectly competitive long-run equilibrium, profit rates on equity, but perhaps not on, say, total capital or assets, should tend toward equality between industries.<sup>4</sup> Although the well-known inconsistencies between accounting and economic profits are always a problem, at least the difficulties created by inflation should be minimized by our choice of data (1959-1964). Moreover, introducing industry growth ( $X_7$  and  $X_8$ ) as a variable should correct for differences caused by accelerated depreciation and over (under) statement of profits (assets) among industries with different growth rates. [See 7, p. 7.] Incidentally, the "average" profit rate for the five-

<sup>1</sup> "This distinction occurred where one corporation controlled another through a dominant minority stock interest" [8, p. 778]. In all the tests presented here "ultimate" control rather than "immediate" control is used.

<sup>2</sup> See [8, 779] for these distinctions.

<sup>3</sup> The proportion of companies in the five groups in 1963 were: (1) 0.0 per cent; (2) 2.5 per cent; (3) 9.0 per cent; (4) 4.0 per cent; and (5) 84.5 per cent. Similar figures prevailed for these groupings as a per cent of assets controlled.

<sup>4</sup> While it is possible to argue that if the above argument is valid, the year-end ratio of equity to assets should be introduced as an explanatory variable, I have not done so. For a study that does include capital structure as an independent variable see [7].

## LIST OF VARIABLES EMPLOYED

- 
- $X_1$  = "Average" rate of return after tax on year-end equity ("invested capital"), 1959-64, (unweighted).<sup>a</sup>
- $X_2$  = Type of "ultimate control": zero if nonmanagement controlled, one if management controlled.
- $X_3$  = Change of "ultimate control": zero if there was no change from 1929 to 1963 in type of control (i.e. from nonmanagement to management controlled or vice versa), one if there was a change.
- $X_4$  = Change in size: zero if the company (or predecessor) either not among the 200 largest firms in 1929 or did not exist in 1929, one if it was also one of the 200 largest companies in 1929.
- $X_5^b$  = 4-digit concentration ratio for the top 8 firms based on value of shipments, 1963.
- $X_6$  = Barriers to entry: zero if classified as either "moderate-to-low" or "substantial," one if "very high."
- $X_7^c$  = Growth rate 1: average annual per cent change of value added (using compound interest rate formula) by manufacture for industries from 1947-53 to 1957-60.
- $X_8^c$  = Growth rate 2: average annual per cent change of value added (using compound interest rate formula) by manufacture for industries from 1957-60 to 1960-64.
- $X_9$  = Sales revenue (or operating revenue if transportation or public utility companies), 1963.
- $X_{10}$  = Total assets employed in the business at year's end, net of depreciation and depletion.
- $X_{11}$  = Invested capital, i.e. net worth (or capital stock, surplus, and retained earnings) at year's end.
- 

<sup>a</sup>. In a few cases profit figures for all years were not available so that the "average" was based on fewer than six years.

<sup>b</sup>. In a few cases 1954 or 1958 figures were employed because the data were not available.

<sup>c</sup>. In a few cases growth rates of Federal Reserve production indexes for industries over the same periods were employed because the data were not available.

*Source of Data:* Variables 1, 9 [15, 16]; variables  $X_3$ ,  $X_5$ ,  $X_6$ ,  $X_{10}$ ,  $X_{11}$ , [8 and his unpublished Appendix, 4, 15, 16, 18, 19, 20]; variable 5, [14]; variable  $X_8$ , [9]; and variables 7, 8, [17].

year period 1959-1963 was also tried with results quite similar to those shown for  $X_1$ . In addition, the rate of return for only a single year, 1963, was also used. Although the results were generally the same as those for  $X_1$ , there is a larger element of chance in utilizing a single year's results.

Variables  $X_2$ ,  $X_3$ , and  $X_4$  are the ones most closely related to Larner's study. Using these three variables an attempt is made to determine whether the type of ("ultimate") control, the change of ("ultimate") control, and the change in asset size exert a significant influence on the rate of return. All three of these are 0-1 "dummy" variables separating broad groupings.

$X_4$  is used to indicate change in asset size if the company has joined the largest 200 firms. The likely significance and even the likely sign of this variable is open to question. There are at least three distinct theories that *could* be used to predict the likely consequences of using this variable. First of all, Hall and Weiss [7, p. 25] found "size does tend to result in high profit rates as Baumol [see 3] proposed." If absolute size and rates of return are positively related, it is not unreasonable to speculate that *changes* of size and profit rates are also associated

positively.<sup>5</sup> On the other hand, there is a well-known thesis that small units find it easier to make big percentage increases than do large units. This would suggest that change in asset size and profits may be negatively associated. Finally, there have been a number of studies too numerous to mention supporting the "law of proportionate effect," i.e., the hypothesis that firm sizes are lognormally distributed. However, in most of these studies it was argued that firms grow at the same rate regardless of initial size, measuring growth in asset or sales terms. One of the most recent studies that specifically concludes that there is no relationship between sales and profitability is Stekler's [11, 12].

Almost all of the "new" theories ("new" in quotations since some of these are chronologically not very new) of the firm—e.g., Alchian and Kessel, Baumol, Becker, Cyert and Cohen, Monsen and Downs, Simon, Williamson *et al.*—suggest that  $X_2$  and  $X_3$  may be important influences on profit rates in that the goal of profit maximization is likely to be vigorously pursued only when it is consistent with the interests of the management group. When divergences exist, managers will follow policies that maximize their gains rather than those of the enterprise. Thus, the separation of management and ownership that has occurred in the U.S. economy over the last 40 years is thought to have undermined the relevance of the profit maximization model. *Ceteris paribus* management controlled firms presumably would be less concerned with profit maximization than nonmanagement controlled firms. In addition, a change in control from nonmanagement to management control should, *ceteris paribus*, be associated with lower profit rates. In short, most of these "new" theories of the firm have stressed the importance of the nonpecuniary motives of managers as contrasted with the pecuniary motives of owner-managers. While I make no claim that the present study provides a systematic test of these "new" non profit-maximum theories of the firm, it does attempt to determine whether these management-related variables exert a significant influence on the rates of return for the selected firms in the various samples included.

Both variables  $X_5$  and  $X_6$  are presumed to be structural characteristics that are reflective of monopoly power. That is, both high concentration and high barriers to entry are expected to be associated with high profits since such concentration or barriers allow control over market prices. Both may be used in the same explanatory model since Bain

<sup>5</sup> Baumol's hypothesis is based on the idea that the large firms have all the alternatives available to small firms plus the investment options requiring capital on a scale sufficiently large so as to exclude small firms. The hypothesis of Baumol is not at all new, since it was put forth by J. Steindl in [10]. Steindl called this the asymmetry principle, and developed it quite extensively. Except for the recent work by Hall and Weiss, time has not dealt kindly with his argument—e.g., H. O. Stekler [11, 12] concludes there is no sales-profitability relationship—but at least he did first put forth the idea.

[2] and Mann [9] have empirically demonstrated that barriers to entry (BTE) and concentration ratios apparently exert independent (and significant) influences on rates of return.

The eight firm concentration ratio (C8) may range in value from 100 to  $8/n$ 's of 100, where  $n$  is the total number of firms in the industry. On the other hand, there are only three classes to denote the difficulty of entry: "very high," "substantial," and "moderate-to-low." The criteria used by Bain [2] and Mann [9] to determine the height of these barriers were scale economies, product differentiation, absolute costs, and capital requirements.<sup>6</sup> The concentration ratio of the eight instead of the four top firms<sup>7</sup> was used since: (a) It usually makes little difference which is used as they are highly intercorrelated (e.g., in Sample 3  $r = .94$  and Sample 4  $r = .96$ ); (b) Bain's original work relating the profit rate and industry concentration used this measure—and so did Mann; and (c) The correlation coefficients in the present study usually turn out to be slightly higher with the eight firm ratio.

Some regressions using a 0-1 "dummy" variable with BTE classified as "moderate-to-low" taking on a value of zero, and BTE classified as "substantial" or "very high" taking a value of one were also run; but are not reported here. Since Mann found that there is a distinct difference between the profit rates of the "very high" barriers group and the other two classes, it is not surprising that variable  $X_4$  is generally more statistically significant than is this other suggested "dummy" variable. Any of the results mentioned but not presented here—such as those equations involving the four-firm concentration ratio, the other barriers to entry "dummy" variable, other measures of profitability, "average" sales, etc. may be obtained from the author on request.<sup>8</sup>

Variables  $X_7$  and  $X_8$  are industry growth variables that are introduced to show the effect of special fluctuations or trends. Although some authors use the Federal Reserve index of industrial production to allow for changes in demand and/or costs of production, this study employs value added.<sup>9</sup> Hall and Weiss explain their use of output as an explanatory variable as follows:

Changes in industry output may reflect either changes in demand or changes in cost that result in movements along the demand curve. Although we cannot distinguish between these, we expect them to have

<sup>6</sup> Bain estimated these barriers for 17 industries and Mann for 30 industries.

<sup>7</sup> The *Fortune* firm data used in this study were matched with the 4-digit SIC by using the industrial classifications for the various firms that were suggested in various Standard and Poor's stock summaries and in [7].

<sup>8</sup> Requests can be addressed in care of the Department of Economics, School of Business & Public Administration, University of Missouri, Columbia, Missouri 65201.

<sup>9</sup> In a few isolated cases where value added figures were not available, the Federal Reserve production index was utilized. For some purposes, such as measuring size, value added is no doubt best since it "compares the value of the factors of production controlled by each firm." [see 8 p. 778 note 2] and [1].

similar effects on profitability. Either an increase in demand or a decrease in costs would result in increased profits unless it is fully anticipated [7, p. 11].

While the sales revenue, variable  $X_2$ , is included in some of the regressions as an indicator of total size and is generally *statistically* significant, it is not regarded as being *economically* significant. That is, sales revenue as a "size" or "scale" variable is not given much credence here despite its statistical significance. First of all, any regressions involving sales (i.e., total revenue) as an explanatory variable when profits (or total revenue minus total cost), in any form, appear as the dependent variable contains a positive spurious correlation, since the identical variable (total revenue) appears on both sides of the equation. Secondly, multicollinearity is a likely problem—i.e., high intercorrelation among the independent variables—in most of the multiple regressions involving sales. The barriers to entry variable, for example, is closely related to sales (e.g., in Sample 4  $r = .423$ ). Thirdly, it is highly probable that the barriers to entry variable,  $X_6$ , would catch many of the "scale" effects. For the absolute capital requirements in the industry was one of the variables Bain and Mann used in assigning firms in their BTE tripartition. Finally, the economic importance of a firm is measured by what it contributes to the national income and to count the contribution of its suppliers is simply double (or multiple) counting. Value-added is a correct flow measure of firm size, just as assets are a correct stock measure. Within any given industry, if the ratio of sales to value-added or to assets runs fairly constant or fluctuates in a random manner, sales may be used as a reasonably good proxy for size, though of course they introduce more statistical error. But when comparing companies across industry lines, sales are an extremely bad measure of size. If they were of any interest, they might as well be used to show profitability, but the ratio between sales and profits is almost meaningless, while the ratio between profits and value added, or profits and investment, is relevant. Unfortunately, value-added data are not readily available. However, this is not as crucial a deficiency as it might be if the flow variables  $X_7$  and  $X_8$  did not use value-added. Although a statistical problem is involved when the rate of return on equity is correlated with assets or net worth, this cannot be helped and these capital figures are used as independent variables ( $X_{10}$  and  $X_{11}$ ). Since the relationship between sales and profitability has been subject to investigation by a number of writers, the sales revenue variable is retained. Although I am personally skeptical about its usefulness, it should be made available for those who are more favorably inclined toward its value. Incidentally, an "average" sales variable for 1959 and 1963 (i.e.,  $[1959 + 1963 \text{ Sales}]$ ) yielded almost

identical results to those based on  $X_2$ .



$X_{10}$  and  $X_{11}$  are total assets and net worth respectively. In general, these variables are highly correlated with sales (the lowest  $r$  between sales and either  $X_{10}$  or  $X_{11}$  in all of the four samples is .74); but can differ significantly for individual industries because of the reasons given above. Hall and Weiss "strongly" support Baumol's thesis that there are "substantial" capital requirement barriers—i.e., size tends to result in high profit later on. Since Baumol defined size in formulating his size-profits hypothesis as the "amount" of owned and borrowed money capital [3, p. 38], total assets are probably a good approximation.

A definition expressed in asset terms is superior to sales or employment concept of size because it is the difficulty in financing large lumps of assets that limits entry to certain fields. Assets are superior to equity, even in an explanation of [the profit rate on equity], because it is the size of the total lump of capital, however financed, that determines the opportunities available to the firm [7, pp. 8–9].<sup>10</sup>

### III. *The Subsamples*

From Larner's 200 firm sample, several subsamples were drawn containing varying numbers of explanatory variables and firms. Results are presented for four of the samples. (a) Sample 1 ( $N=192$ ), which in terms of the number of observations ( $N$ ) is the largest but in terms of the number of variables employed is the smallest, contains complete observations for only variables  $X_2$ ,  $X_4$ ,  $X_8$ ,  $X_{10}$ , and  $X_{11}$ ; (b) Sample 2 ( $N=105$ ) contains complete observations for variables  $X_2$ ,  $X_3$ ,  $X_4$ ,  $X_8$ ,  $X_{10}$ , and  $X_{11}$ . However,  $X_4$  could not be used in the regressions as each of the firms had a value of one for this variable. Data for  $X_8$ , change in control, was particularly difficult to obtain. Larner merely indicated that 87 firms were not among the largest 200 companies in 1929, and he did not indicate the type of corporate control that existed for these firms in 1929; (c) Sample 3 ( $N=112$ ) contains complete observations for all variables but  $X_3$ ,  $X_8$ , and  $X_9$ ; (d) Sample 4 ( $N=47$ ) contains complete observations of all of the eleven variables described in List 1. However,  $X_4$  again could not be employed in the regressions for it had a value of one for all the firms included in the sample. Several other subsets of firms were used but are generally neglected here because of space limitations. (However, these results are available upon written request.) For instance, Samples 1 and 2 were run with all the public utilities eliminated. The surprising result was that the simple correlation coefficients and  $t$ -ratios were approximately the same as with the utilities included. Larner found that although management control was distributed rather

<sup>10</sup> It should be noted that: (a) they measure size as  $1/(\log \text{ assets})$ ; and (b) they argue the significant capital requirement barrier "very likely has a greater effect on profit rates than concentration, the traditional index of market power" [17, p. 25].

evenly among the three industrial groups in 1963, its "highest incidence was among the utilities where it accounted for all but one of the 59 firms."<sup>11</sup>

The reason for having Samples 1-3 even though they do not have complete observations for *all* the variables enumerated in List 1 is to provide the largest sample size possible for several of the key explanatory variables. For instance, in Sample 1 it is possible to obtain coefficients for the key variables  $X_2$  and  $X_4$  (as well as variable  $X_9$ ) using almost all the companies in Larner's 200 firm sample. Sample 2 provides the largest subsample possible using the above three variables along with  $X_3$ , another possibly important management variable.<sup>12</sup>  $X_3$  and  $X_6$  turn out to be the variables that have the least complete coverage. Sample 3 provides the largest subsample possible excluding these two empirically troublesome variables.

#### IV. The Results

##### A. Simple Correlation Analysis

Table 1 presents the simple correlation coefficients between the profit rate,  $X_1$ , and the independent variables,  $X_2$ - $X_{11}$ , described in the "List of Variables Employed" for all four samples. As the previous discussion of the samples indicated, there are not complete observations for all the variables except for Sample 4. Thus, correlation coefficients are not presented for the variables with incomplete observations in the various samples.

Although it is difficult to make a strong case for anything on the basis of zero-order correlation analysis, the bits of evidence presented in Table 1 seem to support several tentative conclusions. (1) The group of management-related variables  $X_2$ - $X_4$  discussed by Larner do not seem to be consistently important determinants of profit rates. The type of control ( $X_2$ ) coefficient is negative, as one might expect following the nonprofit maximization hypotheses of Baumol, Becker, Williamson, *et al.*, that emphasize the present separation of ownership and manage-

<sup>11</sup> [8, p. 785]. He goes on to add: "Yet the public utilities had the lowest incidence of management-controlled firms in 1929 (38 per cent). This drastic change can be explained by the "death sentence" provision of the Public Utility Holding Company Act of 1935, which proscribes pyramiding beyond the second degree among public utility holding companies. Management control was the predominant type of control for the industrials and the transportation companies as well, accounting for 78 per cent of the former and 83 per cent of the latter." Incidentally, I could find only 58 public utilities in his Appendix unless General Telephone and Electronics, listed as an industrial by *Fortune* (AT&T is called a utility, however) is considered a public utility.

<sup>12</sup> Samples 1 and 2 are related in that they focus on variables directly reported by Larner *viz.*, variables  $X_2$ - $X_4$ . It may have been possible to also obtain observations for variables  $X_7$  and  $X_8$  ( $X_8$  is already included) for, say, the 192 firm sample, but not for  $X_2$  and  $X_4$ . Samples 3 and 4 focus on variables  $X_5$ - $X_8$ . The unweighted mean profit rates for the four samples are: Sample 1,  $\bar{X}_1=9.3$ ; Sample 2,  $\bar{X}_1=8.6$ ; Sample 3,  $\bar{X}_1=9.1$ ; and Sample 4,  $\bar{X}_1=8.3$ .

TABLE 1 ZERO-ORDER CORRELATION COEFFICIENTS  
(dependent variable,  $X_1$ , the profit rate)

Independent Variable	Sample 1 ( $N=192$ )		Sample 2 ( $N=105$ )		Sample 3 ( $N=112$ )		Sample 4 ( $N=47$ )	
	(1) Simple Correlation Coefficient, $r$	(2) $t$ -Value	(1) Simple Correlation Coefficient, $r$	(2) $t$ -Value	(1) Simple Correlation Coefficient, $r$	(2) $t$ -Value	(1) Simple Correlation Coefficient, $r$	(2) $t$ -Value
$X_2$	-.001	-0.011	-.114	-1.167	-.065	-0.686	-.148	-1.005
$X_3$	—	—	.169	1.738	—	—	.271	1.887
$X_4$	-.182	-2.556	—	—	-.114	-1.199	—	—
$X_5$	—	—	—	—	—	—	.330	2.344
$X_6$	—	—	—	—	—	—	.502	3.896
$X_7$	—	—	—	—	.277	3.019	.404	2.962
$X_8$	—	—	—	—	.252	2.730	.180	1.299
$X_9$	.275	3.946	.417	4.660	.204	2.182	.450	3.384
$X_{10}$	.081	1.117	.183	1.886	.088	0.928	.403	2.955
$X_{11}$	.081	1.131	.179	1.849	.090	0.945	.364	2.623

Source: See "List of Variables Employed."

ment in large corporations, but is never statistically significant at the .10 or better level. The change in control ( $X_3$ ) coefficient is always positive and is statistically significant at the .10 but not the .05 level. Finally, the results using the change in size variable ( $X_4$ ) are difficult to rationalize. The coefficient is negative, supporting the thesis that small units find it easier to make big *percentage* increases than do large units, in Samples 1 and 3. However, the coefficient in Sample 1 is (negatively) significant at the .02 level and the coefficient in Sample 3 is not significant. I can offer no entirely satisfactory explanation for this pattern. However, it is true that Sample 3 is composed of firms that on the average, in 1929 and 1963, are larger, *in equity, asset, and sales terms*, than are the mean size firms in Sample 1. It may be that the thesis that smaller firms are more likely to grow faster holds, if at all, only up to a certain critical size level. After that critical level the larger firms may have less difficulty enjoying higher profit rates and may even find it easier than small firms. The relationship between profit rates and size may even become positive beyond a certain size class. For instance, once a firm gets to the size of even the smallest member of the "Big Three" automobile manufacturers—Chrysler—scale and profits may be positively related. Thus, the (unweighted) average annual profit rate (net income to net worth) over the 1950–1960 period as reported in *Fortune* was as follows: General Motors, 21.5 per cent, Ford, 14.5 per cent, and Chrysler, 10.5 per cent. The descending firm sizes are therefore associated with descending profit rates.<sup>13</sup> (2) Somewhat surprising is the statistically insignificant relationship between the profit rate and the eight-firm concentration ratio ( $X_5$ ).<sup>14</sup> (3) As expected, the barriers to entry variable ( $X_6$ ) provides an important part of the "explanation" of the level of profit rates. The coefficient is positively significant at the .01 level. (4) The effect of industry growth rates on firm profit rates is generally as expected. However, the correlation coefficient for the growth rate over what should be the more relevant time period,  $X_8$ , is positive but insignificant in Sample 4. As expected it is positively significant at the .01 level in Sample 3. The simple correlation coefficient between profit rates and  $X_7$  is positively significant at the .01 level in

<sup>13</sup> While not computed, this monotonic relationship would almost certainly still hold if American Motors, the smallest of the four major American automobile manufacturers, was also included. This industry is merely given by way of an example. No claim is made that this nice monotone relationship, or anything approaching it, necessarily or even likely holds in all or even a majority of American industries. Incidentally, our results are not necessarily inconsistent with the Hall-Weiss finding that the positive size-profits relationship approximately held over "... the whole range of large scale firms observed" [7, p. 19]. For their limited sample of the 400 largest firms in *Fortune* did not permit them to observe the low end of the size-profits curve. Although the firms within their sample ranged in assets from \$33 million to \$11 billion, 92.3 percent were between \$50 million and \$2 billion.

<sup>14</sup> This was also true for the 4-firm concentration ratios: the simple correlation coefficient between profits and concentration in Sample 3 is  $r = .085$  and in Sample 4 is  $r = .327$ .

both samples. Since most of the data are for *circa* 1963, it was expected that the growth rate over the 1947-53 to 1957-60 period,  $X_7$ , would be less relevant than over the 1957-60 to 1960-64 period,  $X_8$ . (5) Although the sales revenue variable is always positively and significantly related to the profit rate at the .01 level, the relationship is largely specious because of the pronounced positive bias in the equations—i.e., total revenue appears on both sides of the equation. (6) The coefficients for total assets,  $X_{10}$ , and invested capital,  $X_{11}$ , are always positive as expected. However, they are insignificant in Samples 1 and 3, and are significant at the .10 and .01 level for Samples 2 and 4 respectively. Because  $X_{10}$  and  $X_{11}$  are so highly correlated only  $X_{10}$  will be employed in the multiple regressions.

### B. Multiple Correlation Analysis

Within the single-equation least-squares method relied on in the present study, the analysis may be extended by employing multivariate statistical techniques.<sup>15</sup> These results, which are probably more important than those of Table 1, are presented in Table 2.

Only correlation coefficients for Sample 4 ( $N=47$ ), which has complete observations for all of the eleven variables described in the "List of Variables Employed" are presented in Table 2. This is done for two reasons. First of all, in general, the conclusions suggested by the simple correlation analysis presented earlier would not be significantly altered by the multivariate analysis for the other samples.<sup>16</sup> Secondly, space limitations make it preferable to make these additional results available upon written request to the author.

The following tentative conclusions are suggested by the partial results for Sample 4 found in Table 2: (1) The group of management-related variables  $X_7$ - $X_8$  have the same signs as in the zero-order analysis; however,  $X_7$  is always statistically insignificant.  $X_8$  is statistically significant at the .05 level in all five samples, at the .02 (.01) level in equations 8-9 (6, 7). The multiple  $R$  for the equation involving these two variables alone is never statistically significant. The multiple  $R$  does become significant when either sales revenue ( $X_9$ ) or total assets ( $X_{10}$ )

<sup>15</sup> The functions presented here continue to be limited to the linear variety, however. Of course, all the multivariate statistical results must be interpreted in light of any multicollinearity present in the estimating equations. Fortunately, it is no longer necessary to rely on the extremely arbitrary tests involving comparisons of the simple correlations between the independent variables with the multiple  $R$  in any multivariate equation involving these variables or the computationally complex factor analysis tests. For a less arbitrary test that does not involve extensive separate computations as in factor analysis, but relies entirely on transformations of statistics that are generated routinely during standard multiple regression computations. See D. E. Farrar and R. R. Glauber [5].

<sup>16</sup> Thus, for instance, in Samples 1-3 variable  $X_8$  is positively significant at the .05 level in almost all the relevant multiple regressions.

Equation Number	Partial Coefficients of Determination $r^2$ , and ( $t$ -values) of:										Multiple Correlation Coefficient Adjusted for Degrees of Freedom, $R$ , and ( $F$ Statistic)
	$X_3$	$X_2$	$X_1$	$X_4$	$X_5$	$X_6$	$X_7$	$X_8$	$X_9$	$X_{10}$	
1	.068 (-1.796)	.117 (2.417)									.312 (3.479)
2	.067 (-1.763)	.116 (2.378)							.201 (3.293)		.512** (6.453)
3	.066 (-1.745)	.112 (2.327)								.157 (2.829)	.470** (5.356)
4		.091 (2.073)				.165 (2.918)			.088 (2.037)		.583* (8.892)
5		.090 (2.068)				.223 (3.512)				.105 (2.244)	.593* (9.328)
6	.060 (-1.619)	.152 (2.708)		.001 (0.229)		.190 (3.102)		.050 (1.477)			.562** (5.255)
7	.038 (-1.260)	.163 (2.791)		.010 (-0.624)		.206 (3.226)	.092 (2.015)	.025 (1.016)			.603** (5.382)
8	.030 (-1.096)	.138 (2.497)		.000 (-0.017)		.084 (1.888)	.113 (2.230)	.002 (0.303)	.107 (2.162)		.646** (5.705)
9	.026 (-1.030)	.133 (2.451)		.000 (0.025)		.134 (2.457)	.107 (2.162)	.002 (0.283)		.114 (2.235)	.649** (5.788)
Significance Levels of Two-Tailed $t$ -Tests for:											
40 degrees of freedom			$\alpha = .10$		$\alpha = .05$		$\alpha = .02$		$\alpha = .01$		
			1.684		2.021		2.423		2.704		

\* Significant at the 1 per cent level.

\*\* Significant at the 5 per cent level.

Sources: See "List of Variables Employed".

are included in the equation. Apparently if there was a change in ultimate control, this had a favorable influence on the profit rates. And in our sample, this is almost invariably a change from nonmanagement to management controlled rather than vice-versa. This result is in sharp contrast to the usual hypothesis, implicit in almost all the new theories of the firm that suggest that the increasing separation of ownership and management should be associated with less emphasis on profit maximization and more on other goals. Our findings suggest a positive and significant association between profit rates and a change from nonmanagement to management control. Unfortunately, this is not a rigorous text, since following Alchian and Kessell, *et al.*, firms, faced with profit constraints for one reason or another, can enjoy higher nonprofit amenities—thicker carpets, prettier secretaries, greater job security, etc. The data do not allow us to test these theories more precisely.

(2) The simple correlation results showing no significant relationship between profits and concentration is confirmed in the multivariate analysis. While a number of studies, e.g., Stigler [13, esp. pp. 66-71], have found results similar to ours, the prevailing hypothesis in economics is that the average rate of return should be greater for monopolies than that of competitive industries. Apparently our results are at variance with this thesis. The only rationale that I can offer for our findings is that: (a) Sample 4 may be unusual with respect to the average of mean level of concentration. In particular, the unweighted eight (four) firm concentration mean of 69.8 (52.6) may be on the high side; (b) The problem of colinearity, especially between C8 and BTE where  $r_{8,6} = .439$ , if considered serious means the estimated parameters have a low degree of precision. In other words, the C8 is to some extent dependent on BTE. It is usually only when the other elements of competitive structure—capital cost, product differentiation, etc.—are not included in the analysis, that C8 turns out to be an important determinant of profitability; and (c) The 4-digit industry concentration ratios employed may not be entirely appropriate for the firm data used here for a number of reasons.

(3) The BTE variable emerges as an important force in "explaining" firm profit rates. The coefficient has the expected (positive) sign and is statistically significant at the .01 or better level in all the equations in which it appears, save numbers 8 and 9 in which it is significant at the .02 level.

(4) Rather surprising is the fact that  $X_8$  is never statistically significant, while the apparently less relevant, in terms of the time period in question, growth rate variable  $X_7$ , is significant at the .10 level in all three equations in which it appears and at the .05 level in two of these cases.

(5) As expected, the coefficients for sales revenue and total assets are positively significant at the .05 level in two of the equations in which they appear and at the .01 level in the other two cases. In the other case, the coefficient is significant at the .05 level. The reasons for not placing too much emphasis on the sales revenue variable were mentioned earlier. However, the asset size-profitability results are interesting. They lend support to the important conclusions of Hall and Weiss [7, p. 25] that:

... size does tend to result in high profit rates as Baumol proposed, that there is a significant though probably not enormous capital requirements barrier as a result, and that this barrier very likely has a greater effect on profit rates than concentration, the traditional index of market power.

(6) Finally, a number of interesting conclusions emerge from examination of the overall equations. For instance equations 8 and 9 both employ all the independent variables 2-8, while 8 also uses sales revenue and 9 uses total assets. The only differences that result are: (a) the sign for the concentration,  $X_1$ , coefficient is negative in equation 8 and positive in equation 9, but since both are insignificant this may be the result of chance; and (b) the BTE coefficient goes from .10 level statistical significance in equation 8 to the more conventionally acceptable .05 level in equation 9. In short, equation 9 employing total assets, as expected, gives much more sensible and meaningful economic results although there is little to choose between the two in terms of the often misused  $\bar{R}$  or  $F$  statistic comparisons. By the  $\bar{R}$  test these two equations "explain" more of the variance in profitability than any of the other equations. However, in many senses, and in particular comparing the  $F$  statistic associated with the overall equation, equations 4 and 5 are the most satisfactory ones. Using only three independent variables, the equations are able to explain a great deal—in fact, they are the only equations in which  $R$  is statistically significant at the .01 level by the usual  $F$  tests. All the individual coefficients are statistically significant at the .05 level whereas sales or total assets are significant at the .01 level. Thus, the change of control BTE, and total assets (or the less economically relevant sales revenue) variables are able to "explain" a good part of the variability in interindustry profit rates.

### V. Summary and Conclusions

On the basis of my evaluation of the model presented relating the rate of return with several explanatory variables, I conclude: (a) While Lerner's study which corroborates the Berle-Means thesis of increasing management control in the U.S. economy is an important contribution, two of these management-related variables with which he was concerned—type of control and change in size—do not appear to "explain"



very much of the variation in profit rates among the 200 largest non-financial companies included in his sample.<sup>17</sup> However, the change of control coefficient is positively significant in all of the multiple regressions, which while not specifically or systematically tested for in this study is apparently at variance with the "new" nonprofit-maximization theories of the firm that stress the importance of the nonpecuniary motives of managers. (b) Apart from the change of control, the variables which seem to be the proximate determinants of rates of return and for which substantial theoretical support can be given are total assets, barriers to entry, and the industry growth rate. Another variable which was statistically important, but which is theoretically unappealing, is the level of sales revenue.

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<sup>17</sup> Of course, the usual caveat applies to this as well as our other findings, *viz.*, that the conclusion should not be extrapolated to firms smaller than the 200 largest. And, of course, a number of our conclusions are based on samples and not the entire "universe" of 200 firms. In addition, Mr. Lerner wrote me (February 3, 1968) of a change in classification in two of his firms from management to owner controlled. Although he indicated both were borderline cases in which the "control situation is not obvious or clear-cut," I redid all the results and found few significant changes. I have therefore retained the original results. The main changes with the new classification are: (1)  $X_1$  in Table 2 now becomes more consistent by not being significant in equations 1-3 as well as in equations 6-9; (2)  $X_2$  generally becomes more significant. It is significant at the .05 level in Table 1's Sample 4, and at the .02 (.01) level in equations 2, 3, and 4(1) in Table 2; and (3)  $X_7$  ( $X_8$ ) falls below the .05 significance level in Table 2's equation 7(4).

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# POPULATION AND INDUSTRIAL DEVELOPMENT: SOME EVIDENCE FROM TRADE PATTERNS

DONALD B. KEESING\*

To what extent do "internal" and "external" economies of scale handicap small countries in their industrial development? Evidence bearing on this question is reported here, based on preliminary research on the relationship between countries' population and their international trade. The hypothesis investigated is that countries with small populations experience a comparative disadvantage in many important manufacturing industries, uncompensated by a comparative advantage in others.<sup>1</sup> Cross-national regressions are used to identify industries in which small countries seem, from their export and import patterns, to experience a comparative disadvantage.

My regressions are closely akin to those applied previously to output and imports, but not to exports, by Chenery [1] and subsequently, among others, by Maizels [2] and the United Nations [6]. Unlike them, however, I am not chiefly interested in systematic associations between per capita income and manufacturing patterns. Instead, I am seeking further evidence on the country-population effects already implied by some of the regression results of Chenery and the United Nations.

## I. *The Regression Technique*

My regressions were log-linear and explained per capita exports and imports of a country by its per capita gross domestic product and its population:

$$\log \left( \frac{X_i}{N} \right) \left[ \text{or } \log \left( \frac{M_i}{N} \right) \right] = \log a_i + b_{1i} \log \left( \frac{Y}{N} \right) + b_{2i} \log N + \epsilon_i$$

\* The author is a visiting scholar at Stanford University and El Colegio de México. Empirical research was supported by the International Economics Workshop at Columbia University. Results were written up while the author held a grant from the Social Science Research Council. The study owes much to Earl L. McFarland's ingenuity as chief research assistant, and, at the writing stage, benefited from criticisms by Ronald I. McKinnon, William P. Travis, Martin Bronfenbrenner, Frank H. Hahn, Emile Despres, and Alan M. Strout.

<sup>1</sup> Comparative advantage (or disadvantage), unfortunately, lacks an unambiguous operational definition in a world with many commodities, countries, and price-distorting influences. Many economically meaningful yardsticks can be conceived for ranking countries in relation to one commodity, or commodities in one country, but some involve data not observable in practice, and others involve observations influenced by distortions. Here I use the time-honored but confusing terms to indicate that in a given commodity, a small country (in terms of population) can expect to experience a net trade surplus or deficit compared to a large country at the same income level. A more precise lexicon for describing trade, price and efficiency phenomena loosely lumped under "comparative advantage" is urgently needed by those of us who are attempting empirical work.

TABLE 1—COUNTRIES ON WHICH REGRESSIONS WERE BASED  
(on basis of 1964 per capita GDP)

A. Countries considered "developed" (per capita GDP over \$700 in every case, and over \$900 except for Japan):

Australia	Israel
Austria	Italy
Belgium-Luxembourg	Japan
Denmark	Netherlands
Finland	Norway
France	Sweden
Germany (Fed. Rep.)	Switzerland
Iceland	United Kingdom
Ireland	United States

B. Countries included in the larger sample but not in the "developed" sample (per capita GDP under \$700 in every case):

Brazil	Malaysia (Malaya only)
China (Taiwan)	Nigeria
Greece	Portugal
Honduras	Spain
Iran	Trinidad and Tobago
Korea (Rep.)	Turkey
Libya	

where  $X_i$  and  $M_i$  stand for exports and imports of the  $i$ th product,  $N$  represents the country's population, and  $Y$  stands for its gross domestic product.

The regressions were applied to 40 trade categories of manufactured products that together account for a large majority of all trade in manufactures.<sup>2</sup> Empirical observations for 1964 were taken from 31 countries for which detailed commodity trade statistics were available. Besides treating the countries as a single group, I ran the regressions separately for the 18 most developed countries in the sample.<sup>3</sup> The countries are shown in Table 1. I took into account zero or unreported items of trade to stabilize the sample and give weight to zero entries.<sup>4</sup>

Country-size influences were detected by statistically significant deviations from zero of the "size elasticity," Chenery's term for the least squares regression estimate of the partial elasticity with respect to population. A two-tailed  $t$  test was employed at the .05 level of significance. When the size elasticity turned out to be significantly positive for exports, or significantly negative for imports, I interpreted this result to

<sup>2</sup> The products are shown below in Table 2.

<sup>3</sup> Data were taken from United Nations sources, trade statistics from [3] and population, gross domestic product and exchange rates for converting GDP from [4]. I expected, and found, discontinuities in trade patterns between those of developed and less developed countries. Other people may disagree with my assignments of countries to the "developed" category.

<sup>4</sup> I entered the items as one dollar each; zero has no logarithm.

mean that a small country seemed to experience a comparative disadvantage in the industry. The reverse patterns were taken to indicate a comparative advantage.

## II. *Problems in Interpreting the Results*

Several important problems limit the significance of the results. First, there appears to be an inverse correlation between population and per capita natural resources, especially among richer countries.<sup>5</sup> Where people are sparsely settled they are able to export goods and services based on surrounding natural resources, while crowded populations must export manufactures to meet their needs for food and raw materials. Systematic differences in per capita natural resources can be explained to some extent in terms of the interplay of natural geography and differential population growth.<sup>6</sup> The resource situation among advanced countries also reflects the results of large-scale international migration and "polarized" industrial growth, influenced by such factors as the availability of coal, transport facilities and industrial know-how. Thus, a comparative disadvantage of small countries in manufacturing industries may be merely the reverse side of their superior per capita natural resources; or it may mirror historical circumstances that will not be repeated among poorer countries as they industrialize. The same comparative disadvantage could mean, however, that a populous country, for reasons connected with its size, is able to produce a cheaper or better product than a smaller country, or that a larger country enjoys systematic scale advantages in marketing exports.

As a further limitation, regressions tend to pick up the differences in average behavior between countries with large and small populations, but they do not accord special weight to exceptional performances by the smaller countries. Economies of scale may be sufficient to force each

<sup>5</sup> For the 18 developed countries in the sample, the Spearman coefficient of rank correlation between territory per capita and population is  $-.48$  (if Canada and New Zealand are included it is  $-.45$ ). By contrast, for the 13 poorer countries in the sample it is  $.07$ , and for 97 sovereign non-Communist countries with at least 50,000 people each, not including the 20 countries just considered, the rank correlation is  $-.16$ . Again, for 15 developed countries from the sample, there is a  $-.46$  rank correlation between population and the percentage of GDP originating in agriculture, forestry and fishing. These comparisons are based on recent U.N. data [4] [5] [7].

<sup>6</sup> What is really needed, of course, is a whole theory of how countries and their populations come about. One possibility is that "natural" geographical units tend to become countries; and in continental land masses these units vary more in population than in territory. Thus, countries with small populations have more land per person and, in consequence, tend to have more minerals, agricultural and forest resources, tourist attractions and strategic geography (useful for obtaining foreign aid). Densely populated yet very small countries are mostly tropical islands, which at least have tourist attractions. Industrial success may also lead to expansion, immigration and high rates of population growth.

small country to specialize in different products. In that case, regression results for each individual product may be dominated by the general lack of success of small countries, even though one or a few of these countries are able to specialize successfully in each product. The resulting bias grows as products are disaggregated.

In other respects, the regression technique could be expected to understate associations between country size and trade patterns. Scale effects do not necessarily channel themselves into the size elasticity, but may be captured instead by the partial elasticity with respect to per capita income. If a product exhibits a positive income elasticity of demand, as most products do, its market will grow with per capita income. Therefore, the size elasticity will understate, and may fail to pick up, scale effects connected with the size of the local market. In this light, significant size elasticities represent especially impressive evidence.

Other things equal, a large country can be expected to trade internationally a smaller proportion of its output than a small country, because more of its trade counts as national. This effect depresses below zero the expected size elasticities for both exports and imports. Therefore, evidence based on significantly negative size elasticities must be discounted, but evidence based on significantly positive elasticities gains added weight.

Export and import elasticities are interrelated. If a country succeeds in exporting because of scale advantages, it is enabled to import more freely. Thus, there should be a cross-influence pushing export and import elasticities in the same direction, with comparative disadvantages in some industries being offset by comparative advantages in others. My hypothesis is that, despite these cross-influences, small countries find their comparative advantages outside the manufacturing sector.

There are also problems with the form of the equations themselves. Population ( $N$ ) appears in both explanatory variables; but for the countries sampled these variables are uncorrelated in log form. On a theoretical plane, the log-linear equation describes a smoother, more continuous relationship between population and exports (or imports) than one would expect in a relevant general equilibrium model. In a programming model one would expect a discontinuous pattern of association; for example, an industry with intermediate scale characteristics might tend to locate in and export from medium-sized countries. Discontinuities in the relationship between trade patterns and population would probably reduce the statistical significance of the elasticities measured here, blurring my results.

If imports behaved like the average of all goods, the income elasticity of demand for imports, and by extension the "average" partial elasticity

of exports with respect to income, would be unity. Tests of significance for elasticities with respect to income are, therefore, computed here on the basis of deviations from an expected value of one.

### III. *Empirical Findings*

Table 2 summarizes the results for each of forty manufactured products based on four equations, that is, export and import equations applied to the sets of 31 and 18 countries.<sup>7</sup>

Every product except one showed significant country-size effects in at least one equation; and all but four products showed them in at least two equations.<sup>8</sup> Country-size effects appeared more frequently in regressions based on the sample of richer countries than in the full sample. When poor countries were included, country-size effects tended to be overshadowed by the influences of per capita income; these income effects were especially strong in exports, where 38 of 40 products showed partial elasticities significantly greater than one. Among the developed countries, by contrast, effects of per capita income were swamped by those of population.

All told, 105 of the 160 equations turned up significant country-size effects. In all but one case, these effects appeared to operate in a direction unfavorable to a small country. Over half these instances—involving as many as 36 of 40 products in the sample of richer countries—consisted of significantly positive elasticities on the export side.<sup>9</sup> The one exception offers little comfort to small countries: large countries appeared in one sample to import significantly more railroad equipment than small ones!

Another interesting result was that manufactures seemed to exhibit similar export patterns from one product to another. Even standard errors were characteristic. The similarities were especially pronounced for exports of different kinds of machinery and transport equipment. One possible interpretation would be that there are large “external” economies among these industries, or at least among exports of the products.

These regression results, crudely interpreted, overstate the size handicap of small countries, because in most industries there turn out to be one or a few small countries that are successful net exporters. Excep-

<sup>7</sup> Four-digit trade data were unavailable for Sweden and for Trinidad and Tobago, so that these two countries were excluded from the computations in two four-digit categories, rubber tires and cement.

<sup>8</sup> The one product which showed no significant size effect was cement, in which there is less trade than in any of the other 39 products. The extraneous influence of heavy transport costs probably accounted for the poor explanatory power of the equations in this case.

<sup>9</sup> In the case of exports, estimated size elasticities that were statistically significant were also quite large; all but one equalled at least unity, and they ranged from 0.95 (paints, pigments and varnishes) to 2.20 (railway vehicles and equipment in the eighteen-country sample).

TABLE 2—SUMMARY OF REGRESSION RESULTS

SITC Category	Description	Significant Size Effects <sup>a</sup>				Significant Income Effect <sup>a</sup>			
		Exports		Imports		Exports		Imports	
		31 c.	18 c.	31 c.	18 c.	31 c.	18 c.	31 c.	18 c.
266	Synthetic fiber		x		x	x		x <sup>d</sup>	
332	Petroleum products		x	x	x	x			
512	Organic chemicals		x			x		x <sup>d</sup>	
533	Paints, pigments, varnishes		x	x	x	x		x	
541	Drugs, medicines		x	x	x	x		x	x
554	Soaps, detergents		x		x	x			
561	Fertilizers		x			x			
581	Plastics		x		x	x			
629.1	Rubber tires		x	x	x	x			
641	Paper, paperboard			x	x	x			
642	Paper products			x	x	x		x	
651	Textile yarn		x	x	x	x			
652	Cotton fabrics	x	x	x	x				
653	Other textile fabrics	x	x	x	x	x			
661.2	Cement								
664	Glass	x	x	x	x	x			
674	Steel plate, sheet, universals	x	x		x	x			
684	Aluminum		x	x	x	x			
692	Metal containers		x		x	x			
711	Power machinery	x	x	x	x	x		x	
712	Agricultural machinery	x	x	x	x	x			
714	Office machinery	x	x			x			
715	Metalworking machinery	x	x			x			
717	Textile weather machinery	x	x		x	x			
718	Special industry machinery	x	x		x	x			
719	Other non-elec. machinery	x	x		x	x			
722	Elec. power machinery and switchgear		x		x	x			
723	Elec. distribution machinery		x		x	x			
724	Telecommunications equipment	x	x		x	x			
725	Household elec. appliances	x	x		x	x			
729	Elec. machinery & equipment n.e.s.	x	x		x	x			
731	Railway vehicles & equipment	x	x	x <sup>b</sup>		x			
732	Motor vehicles	x	x	x	x	x			
733	Non-motor road vehicles		x	x	x	x		x	
734	Aircraft	x	x	x	x	x			
821	Furniture		x	x	x	x			
841	Clothing			x	x	x	x <sup>d</sup>		
851	Footwear		x			x			
861	Instruments	x	x			x			
894	Toys, sporting goods	x	x			x			

<sup>a</sup> x indicates partial elasticity with respect to population significantly positive for exports, or negative for imports.

<sup>b</sup> Partial elasticity with respect to population significantly positive for imports.

<sup>c</sup> x indicates partial elasticity with respect to income significantly greater than one for exports, or less than one for imports.

<sup>d</sup> Partial elasticity with respect to income significantly less than one for exports, or greater than one for imports.



TABLE 3—SOME TRADE PATTERNS IMPLIED BY REGRESSION RESULTS\*

Country Sample from Which Results Were Taken	Per Capita GDP (US \$)	Per Capita Trade (US \$) with Population of:			
		10 Million		50 Million	
		Exports	Imports	Exports	Imports
31 countries	100	0.01	8.02	0.06	5.32
31 countries	600	0.67	35.16	3.38	23.73
31 countries	2000	56.43	116.96	297.41	82.82
18 countries	1000	24.38	76.25	151.06	39.97
18 countries	2000	27.79	146.67	223.72	73.25

\* Trade patterns are those for the aggregate of the 40 manufactured products shown in Table 2.

tional is a case such as motor vehicles, where only the six industrial countries with populations over 48 million were net exporters in 1964.

An interesting aspect of the results is the balance-of-payments implication that most countries, large or small, rich or poor, could expect to experience a sharp trade imbalance for the 40 manufactured products. For small and poor countries the balance would be negative. These expectations can be quantified by computing, for countries of specified dimensions, the exports and imports implied by each set of fitted equations. Table 3 summarizes five sample results.

These results are exaggerated compared to those that would be achieved using broader trade categories, because of the effects on the regressions of specialization. Nevertheless, the results are not wholly at variance with actual trade balances in manufactures. In 1964, among 20 non-Communist countries with per capita income levels at least equal to Japan's,<sup>10</sup> only seven exhibited a favorable trade balance in manufactures (SITC 5-8). They were the six with the largest populations and Belgium-Luxembourg.

Four others had exports of manufactures at least three quarters as large as imports: Switzerland, Sweden, Austria, and the Netherlands. Like Belgium, they are countries of moderate size (5.8 to 12.1 million people in 1964, with home markets equivalent to \$8.5 billion to \$17 billion). All are centrally located in a heavily populated, industrialized part of the world notable for comparatively open trade and migration policies and a considerable degree of economic integration.

#### IV. Conclusions

The regression results strongly confirmed the hypothesis. Small countries appeared to experience a comparative disadvantage in most

<sup>10</sup> The countries in my "developed" sample plus Canada and New Zealand.

of the important manufacturing industries, uncompensated by a comparative advantage in others.

It is not clear from these results that small countries are seriously handicapped in their industrial development. The findings could be merely the reverse side of a comparative advantage for small countries in goods and services based on natural resources. The regression method is also likely to yield deceptive results when small countries are overcoming scale barriers through specialization.

It is plain, however, that there are systematic differences in countries' trade patterns as a function of their populations. Further research using more refined tools is clearly warranted.

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# THE EFFECT OF UNION STRENGTH ON THE U.S. "PHILLIPS CURVE"

By GAIL PIERSON\*

In this study the U.S. manufacturing sector is divided into groups of strongly unionized and weakly unionized industries in order to evaluate the impact of union strength on the relationship between wage rate changes and unemployment. The basic model is patterned after that of George Perry [5], who found the annual percentage change in average straight-time hourly earnings in the U.S. manufacturing sector ( $W^*$ ) to be significantly related to the inverse of the unemployment rate ( $1/U$ ), the lagged annual percentage change in the consumers' price index ( $C_{-1}^*$ ), lagged profits after taxes as a percentage of stockholder's equity ( $P_{-1}$ ), and the change in the same profits variable ( $\Delta P$ ). The construction of the variables and their sources are similar to those of Perry and are described in the Appendix; regressions are fitted to quarterly data covering the period 1953(I)–1966(II).

As a prelude to the analysis of the effect of union strength, the appropriateness of the model to the manufacturing sector as a whole in the period 1953–1960, one of the periods covered by Perry's study, was verified, but the extension of the data period through 1966(II) revealed that the lagged profits variable was no longer significant. The simple correlation between percentage wage changes and lagged profits is much lower when the later years are added and since there is correlation between lagged profits and unemployment, the latter term picks up most of the remaining influence of profits. Accordingly, the lagged profits term was dropped from the equation.<sup>1</sup> In addition, it was necessary to include a dummy variable ( $S$ ) at the beginning of 1962 to account for the effect of wage-price guideposts. The best equation obtained for the 1953(I)–1966(II) period was:

$$(1) \quad W^* = - .0598 + .2836C_{-1}^* + 17.6576 \frac{1}{U} + .6762\Delta P - 1.0164S$$

(.1187)
(2.2240)
(.3207)
(.2513)

$$R^2 = .66$$

$$\text{s.e.} = .77$$

\* The author is a graduate student at the University of Michigan and is indebted to Professor Harold M. Levinson for the suggestion that this work be undertaken and generous encouragement; to Professors Warren L. Smith and Ronald L. Teigen for helpful comments; also to the National Science Foundation for financial assistance. None of the above bears any responsibility for the results.

<sup>1</sup> The squared simple correlation coefficient ( $R^2$ ) between percentage wage changes and

Perhaps the most interesting result of this equation is the indication that the annual rate of change in wages has been reduced by about one percentage point since 1962(I).<sup>2</sup>

To disaggregate into strong union and weak union groups, 19 two-digit manufacturing industries were ranked according to 1958 estimated ratios of unionization.<sup>3</sup> While these ratios are the best available indicators of union strength, they are not ideal; union strength may be derived from internal political factors such as cohesiveness or from financial considerations rather than from the percentage of workers covered. In addition, the percentage of workers covered by collectively bargained agreements is not synonymous with union membership. It is hoped, however, that the unionization ratios capture some of the important determinants of union strength. The ratios are given in Table 1 below.

TABLE 1—UNIONIZATION RATIOS

Petroleum Refining & Allied Industries	90
Primary Metals	89
Transportation Equipment	87
Rubber & Misc. Plastics	81
Stone, Clay & Glass	78
Paper & Allied Products	76
Electrical Equipment & Supplies	73
Fabricated Metals	71
Machinery, except Electrical	68
Food & Kindred Products	68
Printing, Publishing & Allied Industries	65
Chemicals & Allied Products	65
Tobacco Manufacturing	63
Apparel & Related Products	60
Instruments & Related Products	52
Furniture & Fixtures	50
Leather & Leather Products	49
Lumber & Wood, except Furniture	44
Textile Mill Products	30

Source: [2, p. 347].

lagged profits for the total manufacturing sector fell from .33 in the period 1953(I)–1960(III) to .15 in 1953(I)–1966(II) and that between the unemployment term and lagged profits rose from .19 to .29.

<sup>2</sup> Results similar to this have been found by others. Perry suggested that a shift may have occurred after observing that his 1948–60 equation over-predicted 1961–63 [5, pp. 305–06]. Robert M. Solow reports that Perry's equation overestimates 1965 wage changes by about 1.7 percentage points and describes work by Frank Brechling indicating a difference of about 1.5 percentage points in mid-1965. Solow also points out that one should not be too hasty in attributing the lower rate of wage change to the guideposts for two reasons: the past period of economic slack may have caused a change in expectations about inflation; and the inclusion of hidden unemployment may reduce the difference as is suggested by N. J. Simler and A. Tella. Solow, however, prefers the guideposts interpretation. See [7].

<sup>3</sup> As calculated by H. M. Douty [2]. These ratios are defined as the ratio of production and

The first ten industries were designated group I and the remaining nine group II. It was felt that this grouping was consistent with a strong unionism-weak unionism dichotomy since the average unionization ratio is 78 per cent for group I and 53 per cent for group II.<sup>4</sup> To pursue possible differences even further, subgroups were chosen from the two groups for a greater divergence in average unionization; the four most strongly unionized in the strong union group were designated group A, with average unionization ratio of 87 per cent, and the five most weakly unionized in the weak union group were designated group B, with average unionization ratio of 45 per cent.

### *Groups I and II*

The percentage changes in wages in group II were generally below those in group I up to mid-1963. The average annual change over the period for group I was 3.62 per cent and the average profits rate was 10.7 per cent, compared to 2.97 per cent and 10.3 per cent, respectively, for group II. The results using all variables in the basic model to explain the two wage series were:<sup>5</sup>

$$\begin{aligned}
 (2) \quad W_I^* &= - .2027 + .3057C_{-1}^* + 16.0895 \frac{1}{U} + .0487(P_{-1})_I \\
 &\quad (.0967) \quad (2.5775) \quad (.0878) \\
 &\quad - .1027\Delta P_I - 1.3807S \\
 &\quad (.2522) \quad (.2181) \\
 &\quad R^2 = .79 \\
 &\quad \text{s.e.} = .65
 \end{aligned}$$

$$\begin{aligned}
 (3) \quad W_{II}^* &= - 1.9184 + .0666C_{-1}^* + 9.1712 \frac{1}{U} + .3042(P_{-1})_{II} \\
 &\quad (.1266) \quad (2.4329) \quad (.0904) \\
 &\quad + .0539\Delta P_{II} - .7070S \\
 &\quad (.3057) \quad (.3158) \\
 &\quad R^2 = .44 \\
 &\quad \text{s.e.} = .82
 \end{aligned}$$

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related workers in manufacturing establishments where a majority are covered by collectively bargained agreements to total production and related employment.

<sup>4</sup> By coincidence, it developed that group I includes the Eckstein-Wilson "key group" plus (or minus) the industries they subsequently discovered should have been added (or deleted) on the basis of inherent similarities, with the exception of chemicals, which they found to be on the margin on the group. See [3].

<sup>5</sup> In these and the following regressions the subscripts indicate variables that are calculated for that group of industries. Details of calculations are given in the Appendix.

The small size and insignificance of the coefficients on lagged profits and change in profits in the group I regression persisted in various experiments with current profits, lagged change in profits, etc. While the squared simple correlation coefficient between percentage wage changes and lagged profits is .24, that between the unemployment term and lagged profits is .45, making it difficult for the latter to appear significantly in the presence of the unemployment term. Omitting the profits terms altogether gave the following best result for group I:

$$(2a) \quad W_I^* = .0921 + .3336C_{-1}^* + 17.0042 \frac{1}{U} - 1.3987S$$

(.0806)                      (1.8596)                      (.1975)

$R^2 = .79$   
s.e. = .65

Lagged profits are significant in the group II regression (lagged profits and unemployment are uncorrelated) but the lagged cost of living and change in profits terms are not. Omitting these two terms gave:

$$(3a) \quad W_{II}^* = -1.9966 + 9.1158 \frac{1}{U} + .3235(P_{-1})_{II} - .7589S$$

(2.3911)                      (.0850)                      (.2975)

$R^2 = .43$   
s.e. = .83

Finally, in an effort to improve the explanation of the group II wage changes, an Eckstein-Wilson "spillover" equation was tried, with good results:

$$(3b) \quad W_{II}^* = -2.2352 + .5430W_I^* + .3135(P_{-1})_{II}$$

(.0715)                      (.0615)

$R^2 = .59$   
s.e. = .71

Using  $W_I^*$  lagged was not as satisfactory and neither  $1/U$  nor  $S$  was significant in the presence of  $W_I^*$ , which is as expected since they are already included in the determination of  $W_I^*$ . The better fit from the spillover equation corroborates the Eckstein-Wilson finding that key group wage changes are an important determinant of other wage changes.<sup>6</sup>

<sup>6</sup> To check the direction of causation implied by equation (3b), the regression  $W_I^* = f[W_{II}^*, (P_{-1})_I]$  was performed; the result had low explanatory power ( $R^2 = .13$ ) and lagged profits had a negative coefficient. We conclude that the causation runs as indicated, from the more strongly unionized sectors to the other sectors.

*Groups A and B*

Groups A and B provide a sharper contrast in union strength. The average annual percentage change in wages in group A was 3.79 per cent and for group B, 2.73 per cent, a wider difference than in the case of groups I and II. Profit rate differences were also greater: 11.6 per cent for group A and 7.6 per cent for group B. Using all variables gave the following:

$$\begin{aligned}
 (4) \quad W_A^* &= .1760 + .4647C_{-1}^* + 13.2934 \frac{1}{U} + .1023(P_{-1})_A \\
 &\quad (.1255) \quad (3.3172) \quad (.0901) \\
 &\quad + .8368\Delta P_A - 1.9764S \\
 &\quad (.2551) \quad (.2748) \\
 R^2 &= .72 \\
 \text{s.e.} &= .85
 \end{aligned}$$

$$\begin{aligned}
 (5) \quad W_B^* &= -.8054 + .2175C_{-1}^* + 4.9319 \frac{1}{U} + .3193(P_{-1})_B \\
 &\quad (.1120) \quad (2.5293) \quad (.0753) \\
 &\quad + .3319\Delta P_B - .7923S \\
 &\quad (.2191) \quad (.3270) \\
 R^2 &= .46 \\
 \text{s.e.} &= .80
 \end{aligned}$$

In the group A regression, the profits terms enter more strongly than they did for group I; the coefficient on the change in profits is significant but that on lagged profits is not, reflecting the substantial correlation ( $R^2=.43$ ) between unemployment and lagged profits. Omitting the latter gave:

$$\begin{aligned}
 (4a) \quad W_A^* &= .4947 + .4541C_{-1}^* + 15.8010 \frac{1}{U} + .7747\Delta P_A - 1.9430S \\
 &\quad (.1255) \quad (2.4821) \quad (.2499) \quad (.2740) \\
 R^2 &= .71 \\
 \text{s.e.} &= .86
 \end{aligned}$$

The coefficient on the change in profits is larger in the group B regression than in the group II one, but is still insignificant. Lagged profits, having little correlation ( $R^2=.05$ ) with the unemployment term, appear significantly. Trying a spillover form for group B gave a better

fit:<sup>7</sup>

$$(5a) \quad W_B^* = -1.2828 + .3567W_A^* + .3515(P_{-1})_B$$

(.0680)      (.0540)

$$R^2 = .52$$

$$\text{s.e.} = .75$$

It should be noted that largely because of the method of construction of the variables, all of the equations had positively autocorrelated residuals. This implies that the standard errors associated with the coefficient estimates are smaller than the true standard errors and thus that a more stringent test of significance than the usual rough test of a coefficient against twice its standard error is appropriate. The coefficients whose significance then becomes suspect are notably those on  $C_{-1}^*$  and  $\Delta P$  in the group B regression (5).

### *Implications*

Both the sizes of various coefficients and the ones which are significant differ in the above regressions. Of particular interest is the difference in coefficients on  $C_{-1}^*$ , implying that greater union strength is significantly associated with greater adaptation of wage changes to cost-of-living changes. This affects the stability of a given wage change-unemployment combination by introducing into the wage mechanism a dependence on the previous wage change relative to productivity change. It is comforting, however, that the coefficient on  $C_{-1}^*$  is never larger than one, which would indicate explosive behavior. The best equation for group I, (2a), indicates that about 33 per cent adjustment occurs. The  $C_{-1}^*$  coefficient is insignificant in the group II regressions. Regression (4a) for group A indicates about 45 per cent adjustment, while in the group B regressions the  $C_{-1}^*$  coefficient (.22) is not quite twice its standard error and thus likely insignificant, although larger than the definitely insignificant coefficient in the group II regression (.07). The divergence of the coefficients on  $C_{-1}^*$  is roughly the same between groups I and II (.27) as between groups A and B (.24).

Profits, either in lagged rate or the change-in-profit-rates form, are generally viewed as a determinant of wage changes because they reflect product market or industry conditions: the ability of firms to grant higher wages and/or their willingness to do so rather than undergo a strike. We might expect that, for a given profit rate, stronger unions would tend to have the larger wage gains. On the other hand, stronger

<sup>7</sup> Regressing  $W_A^*$  on  $W_B^*$  and lagged group A profits yielded an  $R^2$  of .26, leading to a rejection of the hypothesis that causation may be running contrary to that indicated in equation (5a).



unions may be consistently able to get higher wage increases rather independently of market conditions while wage gains in the weaker union groups are more sensitive to them. In any event, we have noted the multicollinearity problem which makes it impossible to get comparable coefficients on the lagged-profits-rate term. In addition, if we look at the squared simple correlation coefficients between wage changes and lagged profits by group, the evidence is mixed. While percentage wage changes and lagged profits are more highly correlated for group I than for group II (.24 compared to .11), the group B correlation is higher than that for group A (.26 compared to .17). The change-in-profits term has no collinearity problems and it appears in the regressions for both groups A and B. The larger coefficient on  $\Delta P$  in regression (4) or (4a) compared to that in (5) indicates that strong unions will get larger wage increases for given increases in the profits rate, and for equal percentage changes in the profits rate the strong union advantage is even greater; for decreases in the profit rate this sensitivity is of course a disadvantage.

The lower coefficients on  $S$  in the weaker union groups are as expected because the effect of the guideposts should be to constrain wage changes to 3.2 per cent; since groups II and B have averaged lower wage changes than groups I and A, respectively, less of a reduction is necessary to meet the constraint. Another possible explanation is that guidepost pressure is proportional to prominence in the public eye, which is associated with strongly unionized industries.<sup>8</sup>

The overall implications of these equations can be used to measure the effect of union strength on the terms of the tradeoff between unemployment and price stability. As this requires going from percentage wage changes to percentage price changes, it is necessary either to assume some sort of pricing mechanism or to determine one empirically. Since the focus of this paper is on finding differences in wage or price changes due to differences in union strength, we will use the simple pricing rule that the increase in prices equals the excess of the wage increase over the increase in productivity.<sup>9</sup> The rule is neutral in the sense of describing price changes for which wage and profit shares will remain the same and it has the additional advantage of "holding constant" the effect of pricing policies which may differ by industry, permitting the independent effect of union strength to be isolated.

<sup>8</sup> In a paper published after this study was completed, Perry reports the same uneven impact of the guideposts. He analyzed the wage behavior in sixteen two-digit manufacturing industries classified into two groups according to whether wage settlements tend to be "visible" or "invisible," and found that the wage changes in the visible group were apparently much more susceptible to guidepost pressure. It is worth noting that Perry's "visible" group of nine industries includes (of the industries common to both studies) seven of the industries in our strong union group I, and his "invisible" group of seven industries includes five of the industries in our weak union group II. See [6].

<sup>9</sup> This follows the lead of Perry [5, p. 291].

Table 2 below shows the steady-state wage and price changes implied by the equations for each group at a 4 per cent level of unemployment, assuming productivity growth of 3 per cent annually and the change in profits equal to zero. To approximate the profit rates likely at such a time, the actual values in 1966(II) when the economy was at a roughly 4 per cent level, were used. Wage and price changes are estimated both "without guideposts" (i.e.,  $S=0$ ), and "with guideposts" ( $S=1$ ). Price changes are calculated as though each group were the only group<sup>10,11</sup>

As might be expected, the strong union group (comparing I to II and

TABLE 2—WAGE AND PRICE CHANGES AT FOUR PER CENT UNEMPLOYMENT

Group	Equation	Profits Rate	Without Guideposts		With Guideposts	
			Per Cent $\Delta W$	Per Cent $\Delta$ Prices	Per Cent $\Delta W$	Per Cent $\Delta$ Prices
I	2a	—	5.02	2.02	2.92	— .08
II	3a	14.2	4.88	1.88	4.12	1.12
	3b	14.2	4.94		3.80	
A	4a	—	5.65	2.65	2.09	— .91
B	5	13.1	5.06	2.06	4.05	1.05
	5a	13.1	5.33		4.07	

A to B) has the largest wage increase in the "without guideposts" case. The difference is not particularly great however. On the basis of the regular, i.e., non-spillover, equations, the wage change of the weak union group II is 97 per cent as large as that of group I, and the wage change of group B is 90 per cent as large as that of group A. The "with guideposts" results indicate that the impact of the guideposts is principally on the sectors with strong unions, with the surprising result that wage changes in those industries are less than those of the less strongly unionized. It should be noted, however, that this is not contrary to fact: since approximately mid-1963 the actual percentage wage changes in the weak union sectors have been consistently higher than those in the strong union sectors, a relationship exactly opposite to that existing in the prior period.

The results seem consistent with the conclusions of several studies

<sup>10</sup> Price changes are not given for the spillover equations because of the inappropriateness of assuming the group is the only group.

<sup>11</sup> To illustrate the calculation procedure, the estimated wage change for equation (2a) is as follows:

$$W^*_{I} = .0921 + .3336(W^*_{I} - 3) + \frac{17.0042}{4} - 1.3937(S) = 5.02 \text{ for } S = 0,$$

$$\text{or } 2.92 \text{ for } S = 1.$$

that differences in union strength make little difference in relative changes in wages during periods of low unemployment. [1] [4]. The question that then arises is the effect of union strength in periods of considerable unemployment. Can union strength force a larger change in wages under such conditions?

To analyze this, the unemployment rate was taken to be 5 per cent (the average over 1953-66 was approximately 4-3/4 per cent), and profits where significant were taken at their 1953-66 averages. Productivity growth was assumed as before at 3 per cent and the change in profits at zero. The resulting wage changes are given in Table 3.

The differences in wage changes are now much greater. As before, the stronger union groups are associated with the larger increases and the

TABLE 3—WAGE CHANGES AT FIVE PER CENT UNEMPLOYMENT

Group	Equation	Profit Rate	Per Cent $\Delta W$	
			Without Guideposts	With Guideposts
I	2a	—	3.74	1.64
II	3a	10.3	3.16	2.40
	3b	10.3	3.02	1.88
A	4a	—	4.20	.64
B	5	7.6	2.50	1.49
	5a	7.6	2.88	1.62

weaker groups with the smaller, but the wage change of the weak union group II is now 84 per cent as large as that of group I, compared to 97 per cent at 4 per cent unemployment, and the wage change of group B is only 60 per cent as large as that of group A, compared to 90 per cent at 4 per cent unemployment.<sup>12</sup>

Another interesting difference in the results at 4 per cent and 5 per cent unemployment shows up; the wage changes implied by the spillover equations (3b and 5a) are about halfway between those given by

<sup>12</sup> Since profits have a definite cyclical behavior, it must be asked if any of our results are due to the presence of lagged profits in only the weak union groups. To check this, the equations in which lagged profits appear (although insignificantly) for the strong union groups were used for the "without guideposts" predictions at 4 per cent and 5 per cent unemployment; for group I, equation (2) yielded a wage increase of 5.05 per cent at 4 per cent unemployment, assuming lagged profits equal to the actual 1966(II) value of 13 per cent, and 3.73 per cent at 5 per cent unemployment, lagged profits equal to 10.7 per cent, the 1953-66 average. These are practically identical to the results of equation (2a) as the correlation between lagged profits and unemployment alters the coefficient on the latter when lagged profits are omitted. For group A, equation (4) yielded wage changes of 6.40 per cent and 4.87 per cent, assuming profits rates of 13.2 per cent and 11.6 per cent and 5 per cent unemployment levels. Both of these are higher than the results from equation (4a) but accentuate our conclusions rather than other-

the regular equations in the 4 per cent unemployment period; but at 5 per cent unemployment, the spillover wage changes are much closer to those given by the non-spillover equations (3a) and (5). The spillover effect is apparently greatest in times of tight markets; at 5 per cent unemployment it is negligible. In the "with guideposts" case, 3 out of 4 times the spillover wage change is closer to the regular wage change, which is probably attributable to the uneven impact of the guideposts note above, permitting the weaker union group to have the larger wage increase at any given level of unemployment.

To conclude, it appears that union strength does make a difference; it significantly worsens the terms of the tradeoff between unemployment and inflation. At 5 per cent unemployment the wage-change advantage to strong unionism is in the range of .6 to 1.7 percentage points, indicating a rate of inflation of, say, 1 per cent when prices would otherwise be stable. How much worsening exists at 4 per cent unemployment is hard to determine because the market spreads the wage increases of strong unions into the weaker union sectors so that the wage increase justified by pure market forces cannot be estimated. One would guess, however, that the worsening in the tradeoff terms is greater than at 5 per cent unemployment. The presence of the guideposts apparently eliminates the influence of union strength. Overall, the guideposts cut wage increases by about 1 percentage point but their impact varies, being greatest in the sectors with the stronger unions.

## APPENDIX

*U* Seasonally adjusted unemployment rate as a percent of the civilian labor force. Source: *Surv. Curr. Bus.*

$$C^* = \frac{C - C_{-1}}{C_{-1}} + \frac{C_{-1} - C_{-2}}{C_{-2}} + \frac{C_{-2} - C_{-3}}{C_{-3}} + \frac{C_{-3} - C_{-4}}{C_{-4}}, \text{ where the } C \text{ variables are}$$

quarterly Consumers' Price Index numbers, 1957-59=100. Source: *Surv. Curr. Bus.*

*P* Net profits after taxes as a percent of stockholders equity, calculated as a moving annual average rate:  $P = 1/4(P_0 + P_{-1} + P_{-2} + P_{-3})$ . For the subgroups, profits after taxes and stockholders equity were summed over the industries in the group, then the ratio was calculated. Changes in the sampling procedure occurred twice in the period and necessitated splicing the raw data series; this was done by assuming the most recent sample was correct and the error a linear function of time. Source: *Quarterly Financial Reports of U.S. Manufacturing Corporations*, F.T.C.-S.E.C.

$$W^* = \frac{W - W_{-1}}{W_{-1}} + \frac{W_{-1} - W_{-2}}{W_{-2}} + \frac{W_{-2} - W_{-3}}{W_{-3}} + \frac{W_{-3} - W_{-4}}{W_{-4}}, \text{ where } W \text{ is straight}$$

time average hourly earnings of production workers in manufacturing. Source: *Employment and Earnings Statistics for the United States, 1909-64*, and *Mo. Lab. Rev.* For the period 1956, average straight time hourly earnings were calculated by applying the B.L.S. adjustment factor to average gross hourly earnings. The adjustment factor described in the *Mo. Lab. Rev.*, May 1950, 73, 537-40. To obtain straight time average hourly earnings for each of the four groups, average straight time hourly earnings on an industry basis were weighted by employment in the industry, the weights calculated as the average employment at the beginning, mid-, and near-end points of the period: 1953(I), 1958(IV), and 1965(IV). The weights were:

	Group			
	I	II	A	B
Petroleum Refining & Allied Industries	.017		.050	
Primary Metals	.130		.372	
Transportation Equipment	.164		.468	
Rubber & Misc. Plastics	.039		.110	
Paper & Allied Products	.057			
Stone, Clay & Glass	.060		1.000	
Fabricated Metals	.115			
Machinery except Electrical	.138			
Electrical Equipment & Supplies	.129			
Food & Kindred Products	.151			
	1.000			
Tobacco Manufacturing		.018		
Apparel & Related Products		.237		
Printing, Publishing & Allied Industries		.120		
Chemical & Allied Products		.108		
Lumber & Wood, except Furniture		.128		.248
Furniture & Fixtures		.076		.148
Instruments & Related Products		.050		.096
Textile Mill Products		.193		.373
Leather & Leather Products		.070		.135
		1.000		1.000

- S A dummy variable with value zero from 1953(I) through 1961(IV), and value one thereafter.

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# COMMUNICATIONS

## Consumption, Durable Goods Spending, and Changing OASDHI Seasonality

The permanent-income hypothesis predicts that consumers attempt to even out their consumption stream over long periods of time. Doubt is cast on this theory if consumption responds sharply to unexpected changes in income. Unexpected or "transitory" income is predicted to affect mainly spending on household durables.<sup>1</sup>

The most prominent tests of the permanent-income hypothesis thus far conducted have measured effects of restitutions [16], National Service Life-Insurance dividends [2] [3] [4], and military bonuses [19] on consumption and durable goods spending. Unfortunately the test results remain in conflict despite attempted reconciliations [5] [6] [17] [18]. Although other studies have also attacked the problem [8] [9] [11] [22], there is need for additional evidence as to how different types of transitory income may affect spending for nondurables and services (consumption) and consumer durable goods expenditures (i.e., household investment) [10].

The main transitory income phenomena examined in this paper are several positive and negative changes in disposable income which were caused by unusual movements in the seasonal pattern of employee Old Age, Survivors, Disability and Health Insurance (OASDHI) withholding.<sup>2</sup> Specifically, the question is whether capricious changes in the OASDHI seasonal pattern have affected the seasonal pattern of durable goods spending significantly more than they have the seasonal pattern of current consumption. For example, has unexpectedly early termination of OASDHI withholding stimulated the purchases of, say, household furnishings significantly more than the purchase of commodities like cosmetics or foods? Generally affirmative answers

<sup>1</sup>In Milton Friedman's words:

... any transitory changes in income lead primarily to additions to assets or to the use of previously accumulated balances rather than to corresponding changes in consumption.

.....  
Is not the windfall likely to be used for the purchase of durable goods? Or, to put it differently, is not the timing of the replacement of durable goods and of additions to the stock of such goods likely to some extent to be adjusted so as to coincide with windfalls? [13, p. 28].

Friedman has since drawn a sharper conceptual distinction between windfalls and transitory income, but apparently he has not deviated from the postulate that the correlation between transitory components of income and consumption is zero [15] [14].

<sup>2</sup>Friedman notes that "the precise line to be drawn between permanent and transitory components is best left to be determined by the data themselves, to be whatever seems to correspond to consumer behavior." [13, p. 23].

Although health insurance provisions were not added until 1965, the terminology, "OASDHI," is used throughout this paper.

to these questions will provide modest support for a loose permanent-income hypothesis.<sup>3</sup>

Instead of a single bonus or a single restitution that supplements expected income, the transitory income studied here consists of numerous subtle disruptions of disposable income caused by changes in OASDHI withholding during the period 1952-1964. The disruptions came from two basic causes: (1) Three increases in the taxable OASDHI base tended to increase the duration of withholding for many workers and hence produced negative transitory income changes for any taxpayers who did not realize that the duration of withholding would be extended; and (2) positive transitory income changes resulted, between the base increases, when increases in wages caused many taxpayers to complete payments *for the first time or to complete them earlier* than previously had been experienced.<sup>4</sup> The change in disposable income produced automatically by wage level increases probably also was unexpected by many taxpayers and thus took on the characteristic of positive transitory income.<sup>5</sup>

Unusual changes in the seasonal pattern of OASDHI contributions produced by the forces named above have uniquely produced both negative and positive transitory income. Analysis of effects of these income changes can

<sup>3</sup> This comment is a spinoff from the author's study of *Some Economic Effects of Seasonality in OASDHI Tax Payments*, a research report prepared for the Office of Research and Statistics of the Social Security Administration. Efforts to trace some of the effects of an unneutral tax collection procedure produced an independent body of evidence which now seems best explained in terms of the transitory income component of the permanent-income hypothesis.

<sup>4</sup> A taxable limit not only has been the dominant cause of seasonality in employee OASDHI tax withholding, but when fixed for over a year the limit also has caused individual and aggregate seasonal patterns automatically to change in response to wage level changes. The original OASDHI taxable limit was \$3,000. This limit was raised to \$3,600, \$4,200, \$4,800, and \$6,600 in 1951, 1955, 1959, and 1966 respectively, but wage levels were rising at a faster rate. Consequently, the 93 per cent of total covered earnings which were taxed under the 1938 limit of \$3,000 had fallen to about 73 per cent in 1964. Over the same period the percentage of workers exceeding the annual earnings limit rose from about 3 per cent to over 33 per cent. Whereas only about 6 per cent of male four-quarter civilian wage and salary workers exceeded the taxable limit in 1938, about 62 per cent exceeded the \$4,800 limit in 1964 [20] [21].

The current taxable ceiling of the OASDHI tax is the first \$6,600 of wages or salaries in covered employment. Of course, the greater one's paychecks and the more often one is paid, the faster the ceiling is reached and withholding ceases. For example, one earning \$1,100 per month in 1966 had \$46.20 more per month of disposable income in each of the last six months than in each of the first six. If the same taxpayer's earnings increased to \$1,320 per month in 1967 he would have completed OASDHI payments in five months instead of six. This example indicates the manner in which wage-level growth tended to produce positive transitory income in every year in which the taxable limit was not raised.

<sup>5</sup> Possibly indicative of the lack of knowledge of wage earners about changes in withholding are: First, there has been little notice of OASDHI seasonality, much less its changes, even by professional economists; secondly, where seasonality (or its companion regressivity) has been recognized, its basic cause (the taxable limit) has not been clearly recognized [1] [7]. The extent to which consumers might discount changes in disposable income resulting from changing OASDHI seasonality may also be judged by the fact that the Bureau of Labor Statistics has avoided the problem of calculating the effect of OASDHI seasonality on "spendable income" even though it is aware of the influence of the ceiling on disposable income [23].



throw further light on the permanent-income theory. The test will be whether *changes* in the seasonal pattern of employee OASDHI tax withholdings are inversely associated with *changes* in the seasonal pattern of spending on durable goods to a significantly greater extent than with *changes* in the seasonal patterns of spending on nondurables and services.

The basic data used in testing the responsiveness of seasonal expenditures for consumption and durable goods to changes in aggregate employee OASDHI withholdings are implicit quarterly absolute seasonal adjustment values, i.e., the differences between unadjusted values and seasonally adjusted values. However, these data for the years 1952 to 1964 require two adjustments to hold other factors constant. First, the data require deflation and then a special regression technique is needed.

The seasonal adjustment values for each of the variables are deflated for price, population, and GNP growth to rid them of variation (accentuation) attributable to such expected secular changes.<sup>6</sup> This deflation operation, entailing the normal risk that spurious effects may be introduced, is undertaken to estimate changes in the seasonal patterns of consumption and durable goods variables primarily attributable to endogenous variations in employee OASDHI seasonality ( $E_s$ ). Such changes in  $E_s$ , over the period, have resulted from program changes and from the tendency of growth in even real wages to outpace increases in the taxable ceiling.

The deflated seasonal patterns for  $E_s$  and for one type of spending during the period from 1952 to 1964 can be seen in Figure 1. The scatter diagram is merely suggestive, of course, but the plot of deflated dollar absolute seasonal adjustment values for total durable goods expenditures ( $D_s$ ) against the deflated dollar absolute seasonal adjustment values for employee OASDHI payments,  $E_s$ , indicates that *movements* in the two patterns have been inversely associated in the fourth quarter, the period in which positive transitory income tended to occur from 1952 to 1964. Second, the accentuation of second-quarter employee OASDHI payments, which produced negative transitory income in this quarter over the period, apparently adversely affected expenditures on durable goods to a lesser extent.<sup>7</sup>

But Figure 1 tells no more than simple regression analysis; indeed, it could be misleading if it draws attention to the overall association between the four-quarter patterns and away from the association between changes in the patterns, i.e., the changes in values for each quarter.<sup>8</sup> A multiple regression technique

<sup>6</sup> An alternative to the deflation procedure might have been the introduction of the seasonally adjusted level of real per capita GNP as another independent variable in the equations. In this manner, the explicit effects of a relatively more "permanent" income component could have been introduced into the analysis. On the other hand, introduction of this additional independent variable would have increased the risk of multicollinearity problems.

<sup>7</sup> Data are not yet available [20] [21] to indicate whether the large increase in the taxable limit in 1966, with the resulting change in  $E_s$  seasonality, affected seasonality in spending for durable goods.

<sup>8</sup> Of course, custom and climate play a role in changing seasonality because they are the basis for wants and willingness to spend, but they are necessary rather than sufficient conditions. A seasonal decline in OASDHI payments tends to help make effective some previously dormant fourth-quarter wants and willingness to spend.

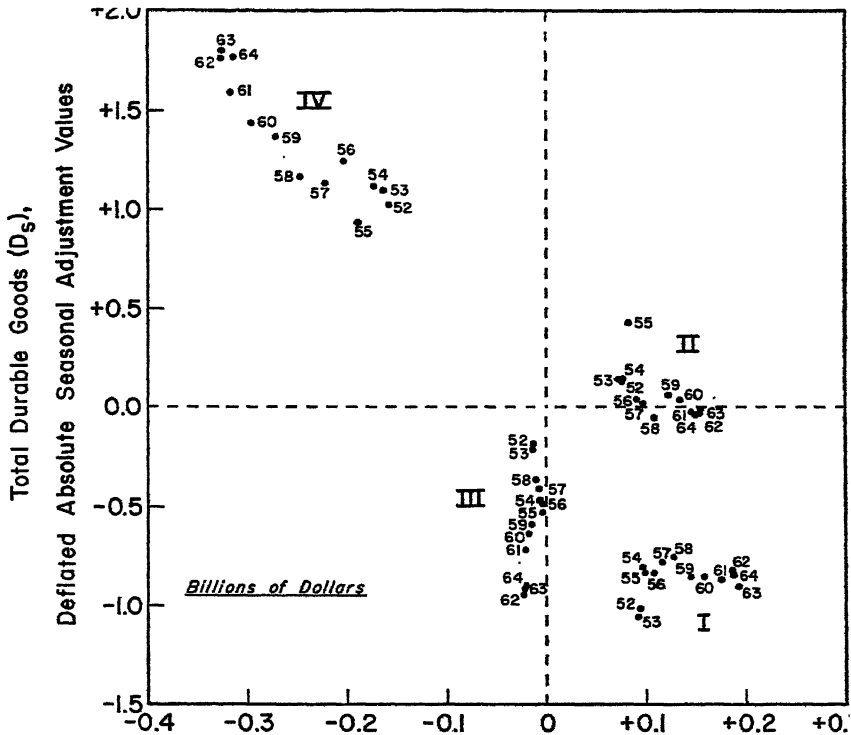


FIGURE 1

must be designed to measure associated changes alone if the effects of such transitory income are to be estimated.

It is possible to estimate the effects produced primarily by changing OASDHI seasonality, i.e., transitory income, with the use of dummy variables. In effect, dummy variables make it possible to measure and then cumulate association between the seasonal values for one quarter at a time with other quarters held constant. When the variables for, say, the fourth quarter are correlated, only *associated changes* in fourth-quarter seasonality are measured. This approach further serves to avoid the bias that there must always be at least one quarter which is seasonally high or low.<sup>9</sup>

Other explanatory variables also are specified in the multiple regression equations mainly to hold constant changes in the seasonal patterns of other sources of household funds. The additional variables in the regressions explaining consumption and durable goods spending, besides the dummy variables  $Q_1$ ,  $Q_2$ , and  $Q_3$ , are the deflated seasonal (adjustment) values for the

<sup>9</sup> Regressions based on the total seasonal patterns, i.e., without dummy variables, would produce a high degree of correlation between  $E_t$  and  $D_t$ , even if the seasonal values in the peak and trough quarters were inversely associated simply because of chance.

personal income tax ( $YT_s$ ), installment credit ( $IC_s$ ), noninstallment credit ( $NIC_s$ ) and current receipts before OASDHI withholding ( $CR_s$ ).

In evaluating Table 1, one might interpret all three of the variables,  $E_s$ ,  $YT_s$ , and  $CR_s$  as "transitory income" variables, as they are all implicit seasonal values, deflated for changing price levels, for population, and for GNP growth. If changes in the seasonal patterns of each of these variables were largely unexpected, i.e., transitory, the first two variables should have significant negative coefficients and the third should have a significant positive correlation. The results are as follows: first, two of the three variables have a significant influence on durable goods seasonality; second, none of the three variables has a significant influence on nondurable goods expenditures; and finally, two of the three variables have a significant influence on service expenditures (although the estimated MPC's are fairly low). Possible distortions due to the seasonal adjustment and deflation techniques aside, these results generally support a loose permanent-income hypothesis.

But, whether  $YT_s$  and  $CR_s$  truly are transitory income variables is questionable. Changes in  $CR_s$  tended to result from changes in the seasonal pattern of payrolls, and thus might have been less unexpected than were changes in employee OASDHI seasonality. Movements in  $YT_s$ , to some extent also functions of payroll changes, probably were caused mostly by underwithholding from taxpayers with high wages and to tax payment behavior of persons earning nonwage income. Before the Tax Adjustment Act of 1966 reformed withholding and income tax installment payment procedures, these taxpayers tended to underpay quarterly installments and to incur increasingly large liabilities at the final filing date. For many taxpayers these developments may have been expected, and thus the transitory nature of this change is doubtful. Hence, it may be more appropriate to interpret and emphasize only the regression results with respect to  $E_s$ .

With  $D_s$  symbolizing durable goods seasonality,  $ND_s$  nondurables, and  $S_s$  services, measures of the association and importance of  $E_s$  in explaining changes in the seasonal spending patterns are as follows: First, one dollar of change in  $E_s$  tends to be inversely associated with \$2.36 of change in  $D_s$ , and this association is statistically significant at the .001 level. Secondly, the partial correlation coefficient ( $r$ ) is  $-.67$ . Thus, the coefficient of determination ( $r^2$ ) is .45 and  $E_s$  explains in the neighborhood of 45 per cent of otherwise unexplained changes in  $D_s$ . Only  $IC_s$  is of greater importance in explaining changes in the seasonal pattern of durable goods spending. On the other hand, the regression coefficients of  $ND_s$  and  $S_s$  against  $E_s$  are not statistically significant, and the respective partial correlation coefficients are only .15 and  $-.20$ .<sup>10</sup>

<sup>10</sup> Since the transitory income components examined in this study are relatively small from the standpoint of individuals (but not in the aggregate) these findings would seem to be at odds with Landsberger's attempted reconciliation [18] of the Bodkin-Kremin controversy. Landsberger suggested that the MPC out of transitory income may decrease sharply as "windfall" income rises and that this might explain the contradictory findings. Yet, the transitory income which was found here to have little or no association with consumption changes was relatively small in amount for individuals.



Thus the seasonal pattern for durable goods expenditures was quite responsive to changes in the seasonal pattern of employee OASDHI payments, while seasonal patterns for consumption and service expenditures were much less sensitive to this type of transitory income. These findings with respect to  $E_t$  appear consistent with a loose permanent-income hypothesis.<sup>11</sup>

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#### APPENDIX A

There apparently has been no consideration of seasonal fluctuations in spending and consumption in recent literature on theories of consumer behavior [12]. Such attention seems desirable for two reasons: first, seasonal fluctuations are quite substantial and thus they should be investigated as macroeconomic phenomena.

CURRENT DOLLAR ABSOLUTE SEASONAL ADJUSTMENT VALUES, 1965  
(billions)

	Q1	Q2	Q3	Q4
Personal Consumption				
Expenditures	\$-23.3	\$-4.8	\$-11.4	\$39.6
Durables	-6.7	.4	-5.5	12.0
Nondurables	-18.1	-5.4	-5.8	29.0
Services	1.5	.2	-.5	-1.4

Source: U. S. Department of Commerce, *The National Income and Product Accounts of the United States, 1929-1965*, Washington 1966, pp. 41, 43.

Secondly, seasonality in household spending is an aspect of consumer behavior important to the firm, a fact not lost on most retailers.

The task of integrating consumer seasonal activity into the consumer behavior theory spectrum does not appear forbidding. Individuals may level their consumption streams over a long period of time by spending more or less during a year than their current incomes would support. But, annual spending determined in the light of permanent-income expectations could still be uneven among the seasons. The consumer (and the economist) need not totally sacrifice awareness of close terrain to gain perception of the "horizon." Hence, seasonality in consumption seems compatible with a life-cycle theory of consumption behavior. Furthermore, movements or changes in the seasonal patterns of consumer expenditures may be of some relevance in evaluating more general theories of consumer behavior, among them the permanent-income hypothesis.

<sup>11</sup> Other implications for consumer behavior theory are suggested in Appendix A.

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### Chicago Economists, Deficit Budgets, and the Early 1930s

"There is clearly great similarity between the views expressed by [Henry C.] Simons and by [John Maynard] Keynes—as to the causes of the Great Depression, the impotence of monetary policy, and the need to rely extensively on fiscal policy" [2, p. 7]. Coming from an authority no less than Professor Milton Friedman, this statement undoubtedly surprised economists who are unaccustomed to hearing Simons and Keynes mentioned in the same breath. The more familiar impression of the views of these two giants was struck five years before Friedman's remarks: in a much-celebrated controversy [9, 5, 1], Professor Lawrence Miller charged that a School of economics crystallized at the University of Chicago during the tenure of Professors Knight, Simons, and Viner and that this School was "consistently less enamored with Keynesian ideas and terminology than the rest of the profession" [5, p. 68]. This apparent conflict is heightened by Friedman's lengthy comparison of the Keynes and Simons interpretations of 1929-33: they both argued that it is collapse of confidence which sets off a demand for liquidity, that this demand cannot be met but the attempts to meet it force liquidation, and that this liquidation includes bank loans with a resultant decline in the quantity of money [2, p. 6]. In short, Friedman argues that both Simons and Keynes emphasized the state of business expectations and the desire for liquidity. Accordingly, Simons and Keynes each turned to fiscal policy—changes in government expenditures and taxes—as their primary tool for promoting economic stability [2, p. 9]. Friedman suggests that the views which Keynes and Simons held in common were also widely shared by Simons' contemporaries [2, p. 4], thereby making Chicago students "much less susceptible to the Keynesian virus than their contemporaries in London, England, and Cambridge, Massachusetts, who were taught that the Great Depression was a necessary and ultimately healthy purgative" [2, pp. 8-9].

Friedman's appraisal of his predecessors surprises many observers because they have become accustomed to associating Chicago economists with the advocacy of limited government and the distrust of discretionary authority in government [5, p. 65]. While these themes might indeed characterize much of their work, they should not be allowed to obscure the facts that Frank H. Knight, Henry C. Simons, Jacob Viner, and their Chicago colleagues argued throughout the early 1930s for the use of large and continuous deficit budgets to combat the mass unemployment and deflation of the times, that they

played an important role in the development of the notion of compensatory public spending, and that they attempted to persuade the Hoover Administration to adopt large budgetary deficits. Strangely enough, these contributions have gone largely uncredited.

While Knight, Viner, and others are understandably amused, if not annoyed, at charges that a School of economics was founded during their tenure, they surely do not deny that there was a remarkable consensus in support of fiscal policy rather than either monetary or wage policy during the early years of the Great Depression.<sup>1</sup> Accordingly, this paper is devoted to a study of this group's professional activities during the pre-Keynesian years 1931-33.

### *Jacob Viner (1931)*

By 1931, the simple truths of compensatory public finance, i.e., that governments should execute budgetary deficits in depression periods and budgetary surpluses in boom periods, had already caught root in the United States. During that year, Jacob Viner was invited to lecture on "Problems of International Commercial and Financial Policy" at the Institute of Politics at Williamstown, Massachusetts. At the seventh meeting of his Round Table, Viner discussed and criticized prevailing American Treasury policy. Viner explained that the Treasury was still practicing traditional policies based on so-called sound principles of finance: taxing heavily, spending lightly, and redeeming debts. Although such policies were sound during periods of prosperity, Viner argued, they were unwise and inappropriate depression policies. Viner advised a precisely opposite depression policy: taxing lightly, spending heavily, and borrowing [7, p. 182]. During depression periods, government may borrow to defray expenditures which give rise to the employment of otherwise idle capital and labor. And inasmuch as the capital and labor would otherwise remain idle, Viner pointed out that "the public works or other useful services so financed during a period of economic depression are from the national economic point of view almost costless" [7, p. 183].

Viner's discussion at Williamstown was one of the first important statements of the "simple truth" of a compensatory role for government spending in this country. Viner was not speaking in isolation, however. According to him, "the idea [that government should utilize deficits in depressions and surpluses in booms] was then [1931] commonplace in my academic surroundings of the time, and I cannot recall that any of my Chicago colleagues would have dissented" [13, p. 264]. This relative unanimity was much in evidence a few months later when the Chicago economists issued an important memoran-

<sup>1</sup>This should not be interpreted as a suggestion that Chicago economists represented a monolithic point of view. For example, it has been pointed out that Paul Douglas and Harry Mills diverged from the consensus on the role of wage policy in recovery and that Jacob Viner and Simeon Leland were more willing than Frank Knight and Henry Simons to abandon "rules versus authorities" for the practical benefits of rapid recovery from the Depression. While supporting the thesis that the Chicago economists failed to be highly monolithic, these differences were not serious in the face of the remarkable policy consensus which characterized the group. Notably, even Knight and Simons proved willing to "weasel" on "rules versus authorities" when they signed the January 1932 telegram to President Hoover.



dum to Congressman Samuel B. Pettengill (Indiana) on the advisability of either borrowing or printing money as a depression remedy.

### *1932 Chicago Memorandum*

In their April 26, 1932 memorandum to Congressman Pettengill, the twelve Chicago economists<sup>2</sup>—including Knight, Simons, Viner—argued strongly in favor of “fiscal inflation” as the means of checking depression and initiating recovery [10, pp. 524-27]. These economists were quick to dismiss recovery by automatic adjustments. Reliance on the automatic process involved “tremendous losses, in wastage of productive capacity, and in acute suffering” [10, p. 524]. They further pointed out that wage and price rigidities were largely the ground on which governmental action was justified. Their advice, therefore, was that recovery could be brought about by injecting enough new purchasing power which, while amenable to abuse, required only courageous fiscal policy on the part of the federal government. To the Chicago economists, action was needed to raise prices, and this action “should take the form of generous Federal expenditures, financed without resort to taxes on commodities or transactions” [10, p. 525].

One of the fears expressed by the Chicago economists was that in the event that their advice was followed, the “fiscal inflation” would be of token proportions. They warned of the danger of emergency-spending schemes whose “inadequate, temporary stimulation might well leave conditions worse than it found them” [10, p. 525]. Convinced that too meager or too short-lived “fiscal inflation” would induce at best only temporary revival and then serious relapse, the Chicago economists’ recommendation was that heavy doses of stimulant should be administered, that they should continue until recovery was firmly established, and that only then should these expenditures be discontinued.

The Chicago economists realized that their recommendation would be received with alarm by some. Accordingly, they appended two arguments. First, they agreed that it was probably best, under the circumstances,<sup>3</sup> for the government to sell new issues of bonds directly to the reserve banks or, in effect, to exchange them for bank deposits and Federal Reserve notes: “much may be said, indeed, for issuing the bonds with the circulation privilege, thus permitting the reserve banks to issue Federal reserve bank notes in exchange; for this procedure does not much invite suspicion, has supporting precedent, and would greatly reduce the legal requirements with respect to gold” [10, p. 526]. Also, they pointed out that “fiscal inflation” was the most promising means of eventually restoring an annually balanced budget and that in the meanwhile Congress should intend to balance the budget over periods of five years or so.

<sup>2</sup> Signers of the memorandum were Professors Garfield V. Cox, Aaron Director, Paul H. Douglas, Harry D. Gideonse, Frank H. Knight, Harry A. Millis, Lloyd W. Mints, Henry Schultz, Henry C. Simons, Jacob Viner, Chester W. Wright, and Theodore O. Yntema.

<sup>3</sup> Some feared that drastic inflation threatened gold. The Chicago economists argued that their policy must be carried through, whatever that policy meant for gold.

*Frank H. Knight (1932)*

On April 20, 1932, Senator Robert F. Wagner decided to sample professional opinion of deficit budgets and addressed letters of inquiry to the foremost economists in the United States. On May 8, 1932, Frank H. Knight replied to Senator Wagner in favor of such tactics: "As far as I know, economists are completely agreed that the Government should spend as much and tax as little as possible, at a time such as this—using the expenditure in the ways to do the most good in itself and also to point toward relieving the depression . . ." [11, p. 10323].

*Simeon E. Leland (1932)*

Part of the widespread outspokenness which the Chicago economists levied against official budgeting philosophy was Professor Simeon E. Leland's lectures on the subject. In October, 1932, Leland addressed the International City Managers' Association Convention on "How Governments Can Best Meet the Financial Crisis." Leland's opinion, commonly shared by his Chicago colleagues, was that public expenditures should be "synchronized with economic rhythms" and that "no hesitancy should be shown in borrowing to finance" capital outlays [4, pp. 109-10]. Leland charged that concern for the annually balanced budget had been responsible for the bulk of real and imaginary crises facing government: "It is erroneously conceived that this is the only proper policy year in and year out, regardless of economic conditions" [4, p. 108]. Leland pointed out that the budget should be geared to economic conditions and that "equilibrium between surplus and deficits should be struck over a period of years rather than annually" [4, p. 108].

*Jacob Viner (1933)*

As the depression deepened, Jacob Viner in particular continued to press for the execution of deficit budgets. In 1933, for example, he delivered a paper in the Day and Hour Series of the University of Minnesota [12]. Here, Viner carefully and somewhat bitterly criticized the "fear campaign" directed towards deficit budgets because it unnecessarily discounted the value of an otherwise sound policy. Viner's point was that countercyclical balancing of the budget calling for deficits during depression periods was part of a sound fiscal policy. Viner chided Hoover for offsetting with fear the beneficial effects of the unintentional deficits executed during the early 1930s: "The outstanding though unintentional achievement of the Hoover Administration in counteracting the depression has in fact been its deficits of the last two years, and it was only its own alleged fears as to the ill effects of these deficits, and the panic which the big business world professed to foresee in these deficits should recur, which have made this method of depression finance seriously risky" [12, pp. 18-19].

Only a few months later but still in 1933, Viner again spoke out on depression policy. Speaking at the Institute of Public Affairs of the University of Georgia, Viner recommended that the most promising method of combating the depression was "that of governmental expenditures financed by borrowing

from the banking system, with the hope that what the banks lend is newly created credit or credit which otherwise would have remained idle" [14, p. 133]. Again, Viner made it clear that sound principles of depression finance justified deficits being met either by new bank credit or by resorting to the printing press. Impatient by now with his antagonists, Viner lashed out that it was a mouldy fallacy to insist on balancing the budget in each year regardless of circumstances: "Why not in each month or week or hour?" [14, p. 129].

Viner then advanced a notion which Chicago economists had made familiar by 1933: the logical period for balancing the budget was the business cycle. And he pointed out that mere balancing was unsound during boom periods when a surplus should be executed either by building up cash reserves or by liquidating debt. This subject, however, became the object of still another pronouncement by the Chicago economists, this time in the form of a public policy pamphlet.

#### *Public Policy Pamphlet No. 1 (1933)*

Still in 1933, some of the Chicago economists<sup>4</sup>—notably Simons and Viner—helped in the preparation of a policy statement regarding balancing the budget [3]. In the Public Policy Pamphlet No. 1, they began by warning of the retarding effects which annually balanced budgets have during depressions. They argued that it was not axiomatic that the federal government should annually collect revenues sufficient to defray even its ordinary operating expenses. Instead, many types of expenditures should be financed by short-term borrowing, long-term funding, or issuance of fiat money.

This Chicago group then repeated the argument which by 1933 had been advanced before every conceivable type of audience: "The balancing of budgets should be regarded as a series of long-term operations in which deficits will be incurred and debts increased during years of economic adversity while Treasury surpluses and the rapid retirement of the public debt will be planned for during years of prosperity" [3, p. 10]. When a series of annual budgets is put together, they continued, the result should be an equilibrium between revenue and expenditures intentionally struck over a period of years rather than annually.

#### *Concluding Remarks*

On at least one occasion, the Chicago economists directly attempted to make their professional advice heard in Washington. In January, 1932, Henry Schultz, Jacob Viner, Garfield V. Cox, Frank H. Knight, John H. Cover, Lloyd W. Mints, Chester W. Wright, Harry D. Gideonse, Theodore O. Yntema, Harry A. Millis, Aaron Director, and Henry C. Simons were among the twenty-four participants of the Harris Foundation who signed a telegram to President Hoover, urging him to act favorably on (1) what later became the Glass-Steagall Act, which broadened the assets eligible for rediscounts with the Federal Reserve and permitted the Federal Reserve to use govern-

<sup>4</sup>Signers of the statement were Frank Bane, Paul Bettors, Carl Chatters, Paul H. Douglas, Simeon E. Leland, H. A. Millis, Clarence E. Ridley, H. C. Simons, Donald Slesinger, Jacob Viner and L. D. White.

ment bonds as well as commercial paper as collateral for its notes; (2) a systematic campaign of Federal Reserve open-market purchases; (3) R.F.C. aid to banks with ineligible assets; and (4) financing a public works program (of a magnitude not less than 1930-31) with deficits<sup>5</sup> [6, pp. 413-15]. Although unintentional deficits occurred during the Hoover Administration, Hoover was not dissuaded from his fetish of an annual balanced budget: the efforts of Knight, Simons, Viner, and the others to persuade Hoover to utilize large budgetary deficits were met with increasing determination to close the unintentional excess of expenditures over revenues.

In a significant way, the policy proposals of Keynes and the Chicago economists were remarkably similar during the early 1930s. Then why were many of this group unsympathetic to the *General Theory*? Friedman's answer—Keynes and the Chicago economists shared views regarding 1929-33, making the latter unsusceptible to the "Keynesian virus"—is only a partial answer. Much of the answer lies in an explanation offered by one of the key figures in the Chicago tradition: those who argued for large deficits from the early 1930s on, but who were critical of (if not hostile to) the *General Theory*, based most of their opposition on an interpretation of it as advocating deficits as a desirable, normal practice and as seeing in deficits a cure-all for everything which ailed the western world. In short, the group which had labored in behalf of the notion of *compensatory* public spending was unsympathetic towards the notion of *secular* public spending which they read into Keynes' *General Theory*.

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\* The author is assistant professor of economics, Iowa State University. This paper is part of a study (cf. J. Ronnie Davis, "Pre-Keynesian Economic Policy Proposals in the United States During the Great Depression," University of Virginia, unpublished doctoral dissertation, 1967) made possible by a grant from the Ford Foundation, which, needless to say, shares no responsibility for its contents. The author would like to thank Frank H. Knight, Jacob Viner, Simeon E. Leland, and Harry D. Gideonse for conversations and letters in which they gave their account of this period and helped with bibliographical difficulties. Also, the author thanks his colleagues Dudley G. Luckett and Charles W. Meyer for their suggestions which improved earlier drafts of this paper.

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### A Comment on the Marginal Physical Product Curves for the CES and VES Production Functions

Some confusion seems to exist regarding the monotonicity of the marginal product curves for the CES production function [1]. This note demonstrates those conditions under which the marginal product curves are not monotonic. It will be seen that monotonicity depends upon both the values of the substitution and returns to scale parameters. The method used to analyze the CES case is applied to the Variable Elasticity of Substitution (VES) production functions [3] [4] as well.

Writing the CES production function as:<sup>1</sup>

$$(1) \quad y = \gamma[\delta K^\rho + (1 - \delta)L^\rho]^{\nu/\rho},$$

where  $y$  denotes output,  $K$  capital input,  $L$  labor input,  $\gamma$  is the neutral efficiency parameter,  $\delta$  is the distributive parameter,  $\rho$  is the substitution parameter, and  $\nu$  is the returns to scale parameter. One derives:

$$(2) \quad f_L = \frac{\nu(1 - \delta)\gamma L^{\rho-1}}{[\delta K^\rho + (1 - \delta)L^\rho]}, \quad f_K = \frac{\nu\delta\gamma K^{\rho-1}}{[\delta K^\rho + (1 - \delta)L^\rho]},$$

<sup>1</sup> Note that  $\rho$  as used in this paper is the negative of the substitution parameter as defined by [1]. The analysis is made somewhat more elegant by this substitution.

where  $f_L, f_K$  denote the marginal product curves for the CES with respect to labor and capital respectively. Owing to the symmetry with respect to  $K$  and  $L$  in the CES function one need consider only one of  $f_L, f_K$ . Thus, let  $L^* = rL$ ,  $0 < r < 1$ , and consider the ratio  $f_L/f_{L^*}$ . If  $f_L$  is a monotonically nonincreasing function of  $L$ , then  $f_L/f_{L^*} \leq 1$  for all  $L$  contained in the domain of definition of " $f$ ". If  $f_L$  is nonmonotonic, then for some  $L$ ,  $f_L/f_{L^*} \leq 1$  and for other values of  $L$ ,  $f_L/f_{L^*} > 1$ .

The ratio  $f_L/f_{L^*}$  is given by:

$$\begin{aligned} f_L/f_{L^*} &= \left( \frac{[\delta K^\rho + (1-\delta)L^\rho]}{[\delta K^\rho + (1-\delta)L^{\rho r^\rho}]} \right)^{(\rho/\rho-1)} r^{1-\rho} \\ (3) \quad &= r^{1-\rho} \left( \frac{P}{W} \right)^{\rho/\rho-1} \end{aligned}$$

where  $P = [\delta K^\rho + (1-\delta)L^\rho]$  and  $W = [\delta K^\rho + (1-\delta)L^{\rho r^\rho}]$ .

There are four cases to be considered:

(i) If  $\rho = 0$ , the CES production function reduces to a Cobb-Douglas function of form:

$$y = \gamma K^{\nu\delta} L^{\nu(1-\delta)},$$

which has returns to scale parameter equal to  $\nu$  and first partial derivatives:

$$f_L = \frac{\nu(1-\delta)y}{L}, \quad f_K = \frac{\nu\delta y}{K}.$$

As is well known, if  $\nu(1-\delta) \leq 1$ , then  $f_L$  is a nonincreasing function of  $L$ ; and if  $\nu\delta \leq 1$ , then  $f_K$  is a nonincreasing function of  $K$ .

(ii) If  $\rho = 1$ ,  $f_L/f_{L^*} = [P/W]^{\nu-1}$  and  $[P/W] > 1$ .  $f_L$  is monotonically nonincreasing only if  $\nu \leq 1$ . If  $\nu > 1$ ,  $f_L$  is monotonically increasing.

(iii) If  $0 < \rho < 1$ ,  $\lim_{L \rightarrow 0} f_L/f_{L^*} = r^{1-\rho}$ ,  $\lim_{L \rightarrow \infty} f_L/f_{L^*} = r^{1-\rho}$ .  $f_L$  is decreasing for small  $L$  for any  $\nu$ , but is nonincreasing for large  $L$  only if  $\nu \leq 1$ . If  $\nu > 1$ , then for large  $L$   $f_L$  is an increasing function of  $L$ .

(iv) If  $\rho < 0$ ,  $\lim_{L \rightarrow 0} f_L/f_{L^*} = r^{1-\rho}$ ,  $\lim_{L \rightarrow \infty} f_L/f_{L^*} = r^{1-\rho}$ . If  $\nu \leq 1$ , then  $f_L$  is monotonically decreasing for all  $L$ . If, however,  $\nu > 1$ ,  $f_L$  is an increasing function of  $L$  for small  $L$  and a decreasing function for large  $L$ . This latter case is interesting for it exhibits a "neo classical" property of production functions not held by the Cobb-Douglas, which is the most widely used function.

To summarize, if  $\nu \leq 1$ , then  $f_L$  is monotonically nonincreasing for any value of  $\rho$ . If  $\rho = 0$ , one has the case of the Cobb-Douglas production function which has monotonic partials for any value of  $\nu$ . The function  $f_L$  is nonmonotonic if  $\nu > 1$  and  $\rho \neq 0$  or 1. Thus, ignoring the two special cases of the CES corresponding to  $\rho = 0$  and  $\rho = 1$  (the Cobb-Douglas and linear production function cases respectively), one notes that the marginal product curves will be nonmonotonic if the returns to scale parameter is greater than one.

The extension to the generalized CES production function of Dhrymes and Kurz [2], where the production function is defined by:

$$(4) \quad y = \gamma[\delta_1 K^{\beta_1} + \delta_2 L^{\beta_2}]^{1/\rho},$$

follows easily using the approach outlined above. One notes, however, that in this case the conditions for monotonicity depend upon the values of three parameters,  $\beta_i$ ,  $i=1$  or  $2$ ,  $\nu$ , and  $\rho$ . Note also that the marginal product of labor may be monotonic and that of capital nonmonotonic or vice versa.

Consider now the variable elasticity of substitution production function (VES) in the form considered by Revanker [3]:

$$(5) \quad y = \gamma K^{\alpha(1-\delta\rho)} [L + (\rho - 1)K]^{\alpha\delta\rho},$$

where  $y$ ,  $K$ ,  $L$  have the same interpretation as before. The parameters, however, are different in the two functions. Using " $f_L$ " and " $f_K$ " to denote the marginal product curves for the VES, one has:

$$f_L = \frac{\alpha\delta\rho y}{L + (\rho - 1)K}, \quad f_K = \alpha(1 - \delta\rho)y/K + \frac{\alpha\delta\rho(\rho - 1)y}{L + (\rho - 1)K}$$

These curves are nonnegative if one assumes that  $\alpha\delta\rho$  and  $L + (\rho - 1)K$  are nonnegative. Under these assumptions we proceed to analyze the marginal product curves for the VES.

As with the CES production function consider the ratio  $f_L/f_{L^*}$ , where  $L^* = rL$ ,  $0 < r < 1$ , for any  $L$ . Letting  $P = [L + (\rho - 1)K]$  and  $W = [rL + (\rho - 1)K]$ , one has:

$$(i) \quad [P/W] > 1,$$

$$(ii) \quad f_L/f_{L^*} = [P/W]^{\alpha\delta\rho-1},$$

so that if  $\alpha\delta\rho \leq 1$ ,  $f_L$  will be nonincreasing for all  $L$ .

Because of the asymmetry of the VES production function one must now examine the marginal physical product curve for capital. Similarly to the previous case one considers the ratio  $f_K/f_{K^*}$ , where  $K^* = rK$ ,  $0 < r < 1$ . The first partial derivative with respect to  $K$  is given by:

$$f_K = \gamma K^{\alpha(1-\delta\rho)} [L + (\rho - 1)K]^{\alpha\delta\rho} [\alpha(1 - \delta\rho)K^{-1} + \alpha\delta\rho(\rho - 1)(L + (\rho - 1)K)^{-1}].$$

For  $K$  small and any non-negative  $L$ ,

$$\frac{f_K}{f_{K^*}} \doteq \left(\frac{1}{r}\right)^{\alpha(1-\delta\rho)} \cdot r = r^{1-\alpha(1-\delta\rho)},$$

as  $(L + (\rho - 1)K) \doteq L$ . Thus, if  $\alpha(1 - \delta\rho) \leq 1$ ,  $f_K$  is nonincreasing for small  $K$ , and if  $\alpha(1 - \delta\rho) > 1$ ,  $f_K$  is an increasing function of  $K$  for small  $K$ . If  $K$  is large,  $[L + (\rho - 1)K] \doteq (\rho - 1)K$  so that:

$$f_K \doteq \gamma K^{\alpha(1-\delta\rho)} (\rho - 1)^{\alpha\delta\rho} K^{\alpha\delta\rho} [\alpha(1 - \delta\rho)K^{-1} + \alpha\delta\rho K^{-1}],$$

$$\therefore \frac{f_K}{f_{K^*}} \doteq \left(\frac{1}{r}\right)^{\alpha-1} = r^{1-\alpha},$$

in which case  $f_K$  is nonincreasing if  $\alpha \leq 1$ . Thus, one concludes that, if  $\alpha \leq 1$  and  $\alpha(1-\delta\rho) \leq 1$ ,  $f_K$  is monotonically decreasing. On the other hand, if  $\alpha(1-\delta\rho) > 1$ , then for small  $K$ ,  $f_K$  is an increasing function of  $K$ , but for large  $K$  is decreasing. However, as one requires  $0 < \alpha\delta\rho \leq 1$  for  $f_L$  to be nonnegative and a decreasing function of  $L$ , the latter case will not hold.

In summary, for values of  $\alpha$  and  $\alpha\delta\rho$  which satisfy the neoclassical conditions that the marginal product curve should be positive and nonincreasing over some domain of the function, the VES has marginal product curves which are monotonically decreasing functions of their respective arguments.

In conclusion, therefore, one notes that of the three production functions currently being discussed in the literature, namely the Cobb-Douglas, CES, and VES production functions, only the CES has the property of nonmonotonic marginal product curves for certain values of its parameters. The discussion above has shown that for the VES both marginal product curves are monotonic. The properties of the Cobb-Douglas are well known and do not warrant discussion.

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\* The author is assistant professor of economics at Michigan State University. He wishes to thank a referee of this paper for correcting one of the author's foolish mistakes, and to thank The Public Utilities Institute at Michigan State for its financial assistance.

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### On Varying the Constants in a Linear Programming Model of the Firm

The articles by Robert Dorfman and William Baumol in this journal have done much to familiarize its readers with the usefulness and economic meaning of linear programming [6] [2]. Other contributions have extended this discussion [1] [3] [5] [7] [11] [12]. Further appreciation of some of its characteristics and potentiality can be gained by exploring the effect on an optimal program of varying the constants.<sup>1</sup> In the usual linear pro-

<sup>1</sup> The systematic procedures for such analysis where the original values of the constants are varied or are changed continuously into new values are usually referred to as parametric linear programming [8, pp. 220-31] [9, pp. 123-42] [10, pp. 379-95].



gramming problem the constants represent such things as (a) fixed capacities or availabilities of factors of production, (b) constant unit variable costs, unit revenues, or unit profits, and (c) constant rates of utilization of each factor capacity per unit of product output. For purposes of exposition a simplified example which lends itself easily to graphical description will be examined.

### I. A General Formulation

Consider the case of a firm faced with a production decision for a future period. A single product is produced which can be accomplished by only two different processes. Each process uses different, but constant, amounts of the fixed factors in producing each unit of product. Only two fixed factors exist and variable factors may be acquired in amounts needed in a purely competitive market. Also, the product output can be sold in a purely competitive market. The problem can be viewed as one of choosing a production program (that is, a combination of processes) which maximizes total profit subject to the restriction that the program does not require more of any of the fixed factors than is available.

A common general notation for the case of two variables and two restraints, and the nonnegativity conditions, gives us the following formulation:

$$(1) \quad \text{Maximize } f = c_1x_1 + c_2x_2$$

subject to the following constraints

$$(2) \quad a_{11}x_1 + a_{12}x_2 \leq b_1$$

$$(3) \quad a_{21}x_1 + a_{22}x_2 \leq b_2$$

$$(4) \quad x_1, x_2 \geq 0$$

where

$f$  = total profit, to be interpreted as the excess of total revenue over total variable costs or "profit" before deducting fixed costs.

$x_1$  = level of Process 1, to be interpreted as the number of units produced by Process 1

$x_2$  = level of Process 2, to be interpreted as the number of units produced by Process 2.

$b_1$  = quantity of Factor 1 available

$b_2$  = quantity of Factor 2 available

$a_{11}$  = amount of  $b_1$  used in the production of each unit of output by Process 1

$a_{12}$  = amount of  $b_1$  used in the production of each unit of output by Process 2

$a_{21}$  = amount of  $b_2$  used in the production of each unit of output by Process 1

$a_{22}$  = amount of  $b_2$  used in the production of each unit of output by Process 2

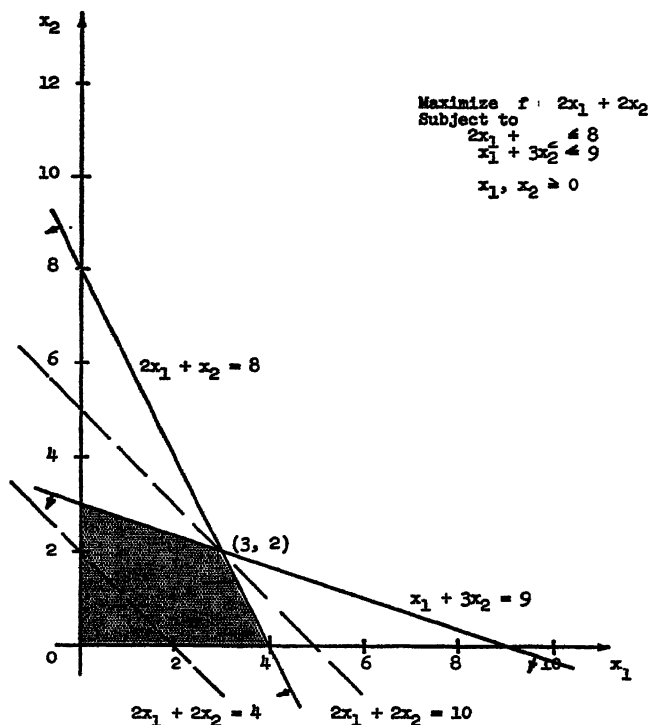


FIGURE 1

$c_1$  = profit per unit of output produced by Process 1

$c_2$  = profit per unit of output produced by Process 2

## II. A Numerical Example

A simple numerical example will serve to convey the effect of the subsequent varying of the constants in the original problem. The original problem may be represented in the following way:

(5)  $\text{Maximize } f = 2x_1 + 2x_2$

subject to the following constraints

(6)  $2x_1 + x_2 \leq 8$

(7)  $x_1 + 3x_2 \leq 9$

(8)  $x_1, x_2 \geq 0$

The graphical solution may be viewed in two ways. First, by plotting the constraint inequalities and the objective function on the  $x_1$  and  $x_2$  axes as shown in Figure 1. The shaded area represents the intersection of the sets defined by the inequalities (6), (7), and (8) and can be interpreted as the

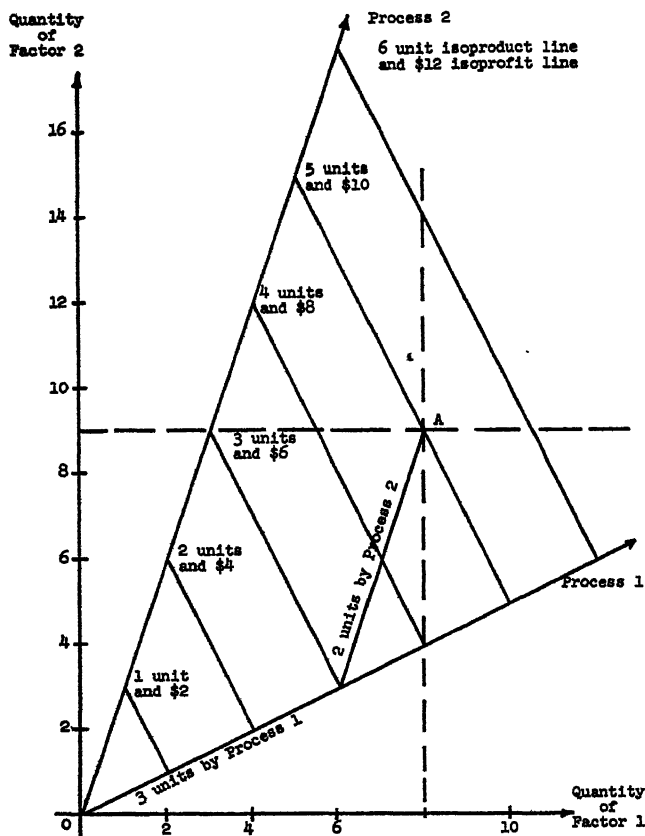


FIGURE 2

set of all feasible programs. In this example an optimal feasible program is the point of intersection of the graph of (5) for  $f=10$  and the feasible solution set.<sup>2</sup> This intersection is a point in the set that is "most distant" from the origin in the "optimizing direction." The program is  $x_1=3$ , that is, 3 units by Process 1; and  $x_2=2$ , that is, 2 units by Process 2. Total output is 5 units, the sum of the outputs by each of the processes. Total profit is \$10.00.

The second graphical solution is seen in Figure 2. The same problem now is graphed with quantity of Factor 1 on the horizontal axis and quantity of Factor 2 on the vertical axis. Attention now is focused upon the Process 1 and Process 2 production rays and some relevant isoproduct and isoprofit lines. The dashed lines perpendicular to the axes represent the

<sup>2</sup> Linear programming problems can have one, two, or infinitely many optimal solutions. However, the initial example considered here and its subsequent changes with new values for the constants will have unique optimal solutions.

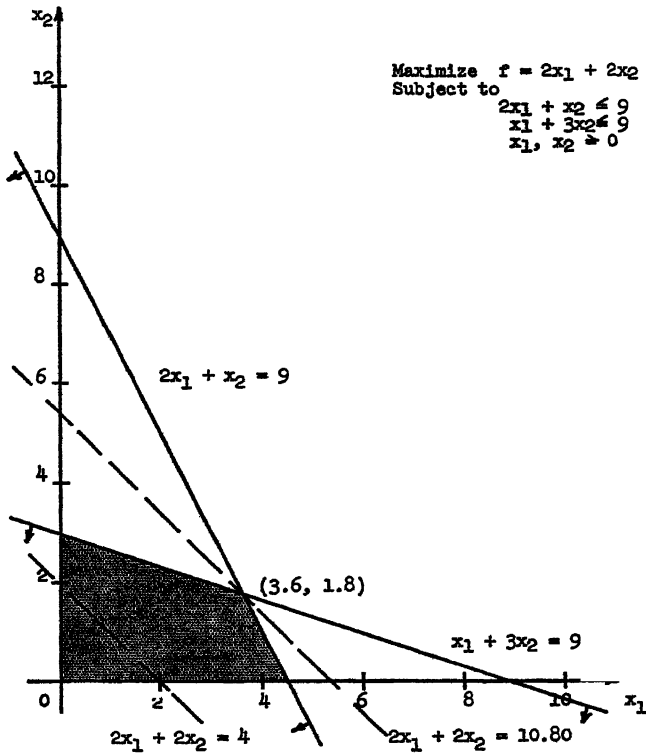


FIGURE 3

existing factor limitations on attaining higher isoproduct or isoprofit levels. The optimal output is observed again to be 5 units with \$10.00 profit. The highest isoprofit line which still intersects a point in the feasible area is seen at point A. The optimal combination of processes is not so directly seen, but the only way 5 units of output is possible is to go out 3 units on Process 1 ray and 2 units on Process 2 ray or vice versa [6, pp. 805-6] [1, p. 278].

The constants  $c_j$ ,  $b_i$ , and  $a_{ij}$  now might be varied one at a time in the original numerical problem. The effect upon optimal output, optimal combination of processes, and optimal profit can thus be observed. There will be a return to the original problem as the value of one constant after another is altered.

#### *Changes in the $b_i$*

By varying the  $b_i$  values the effect of such things as increases or decreases in resource availabilities can be explored. Let us increase the  $b_1$  in (6) from 8 to 9. This increases the quantity of Factor 1 available and the effect on optimal output, program, and profit can be seen from Figures 3 and 4. The output is now 5.4 units; the program is:  $x_1 = 3.6$ ;  $x_2 = 1.8$ ; the total profit

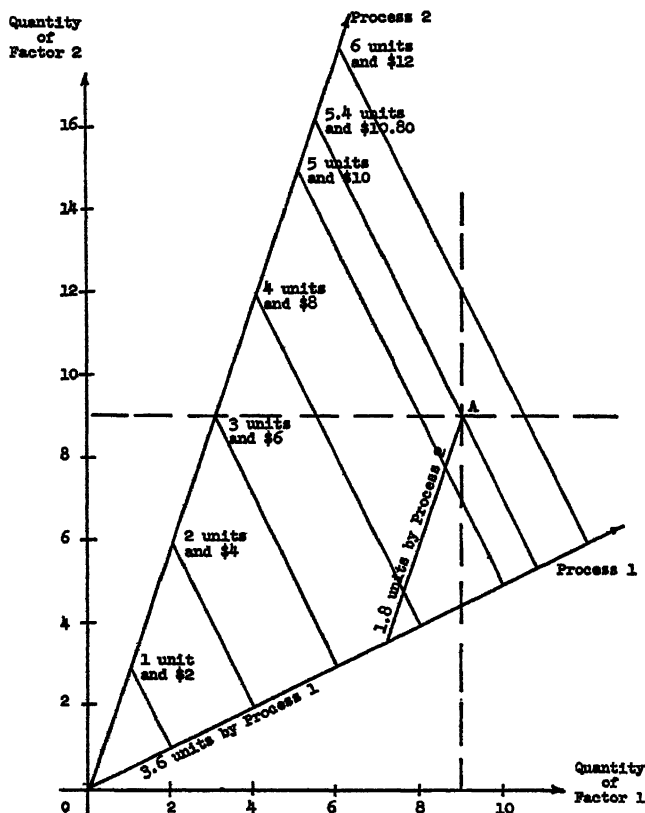


FIGURE 4

is \$10.80. The effect on profit is of special interest. The marginal contribution to profit of the 9th unit of Factor 1 (not taking into account its cost) is  $\$10.80 - \$10.00 = \$0.80$ .

If there had been no variable costs in the example so that unit profits in the objective function were equal to unit revenues the increase in the total profit level from the unit increase in Factor 1 would give us the familiar marginal revenue product of the factor over that particular unit interval.

#### *Changes in the $c_j$*

The  $c_j$  values in the example represent profits for each unit of output by each process. Unit profit is to be interpreted as the excess of unit revenue over unit variable cost. Thus, changes in unit profits may arise from (a) a change in price in the market for the output, (b) a change in price in the market for the variable factor, or (c) a combination of (a) and (b).

Thus with this extremely simple example we can illustrate the nature of the procedure for deriving the firm's supply schedule in the output market.

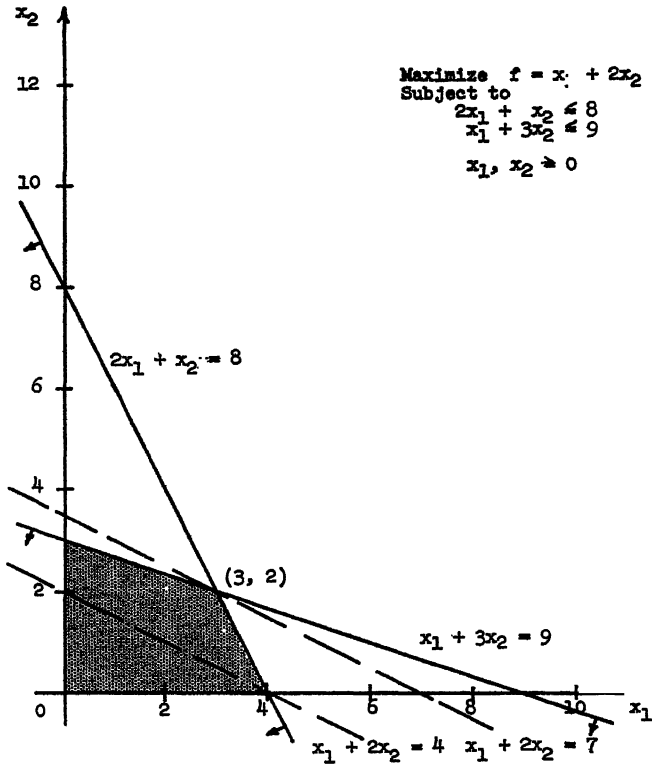


FIGURE 5

With merely two processes the supply schedule is not very interesting but realism can be approached by including more processes, products, and factors. If price in the output market increased by an amount which increased unit profits,  $c_1$  and  $c_2$ , from \$2.00 to \$4.00 in (5) the optimal output and program would remain the same. Thus, within that output price range, and for this short-run period, the firm would continue to supply 5 units of output, but now would be attaining a profit level of \$20.00. When numerous products as well as processes are involved all the  $c_i$  would typically not change together and thus the slope of the objective function would change, often resulting in different optimal outputs and programs.

A change in the  $c_i$  might also come about due to a change in unit variable cost associated with a single process or a group of processes. To illustrate in terms of the numerical example let us say unit variable cost rises in production by Process 1 so that  $c_1$  decreases from \$2.00 to \$1.00. Say a price increase occurred in the market for the variable factor which is used in Process 1 but is not used in Process 2. Suppose further that its price increase caused the above unit profit change in  $c_1$ . Any change in the amount of output produced by Process 1 will in turn cause a change in the amount of

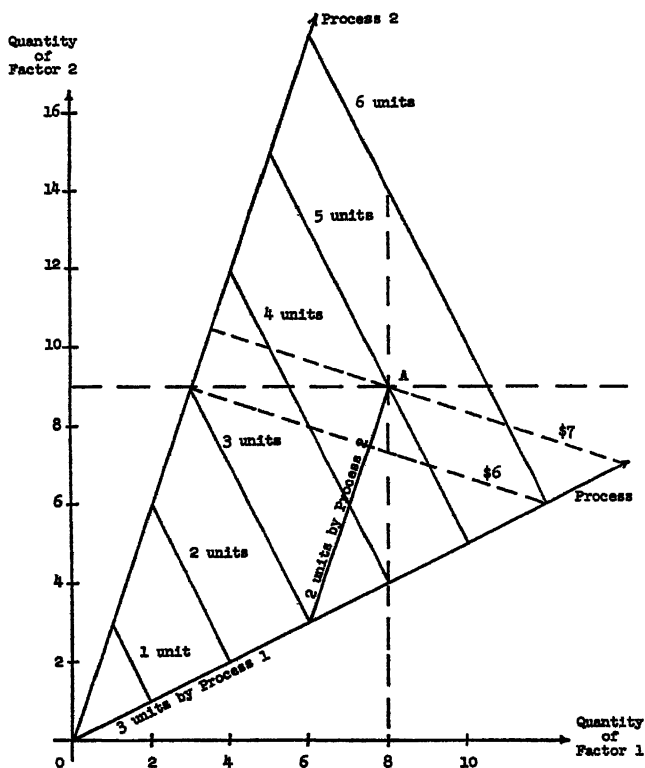


FIGURE 6

the variable factor required by that process. Thus, the firm's short-run demand schedule for the variable factor could be derived in this fashion.

In the simple example the effect of the change in  $c_1$  can be seen in Figure 5. The slope of the objective function changes but the optimal output remains at 5, and the optimal program remains:  $x_1=3$ ;  $x_2=2$ . The value of this optimal program, however, has fallen to \$7.00. A graphical solution also appears in Figure 6. The highest isoprofit line attainable is \$7.00 and the associated optimal output and optimal program also can be observed.

#### *Changes in the $a_{ij}$*

In producing a unit of output by Process 1,  $a_{11}$  units of Factor 1 would be used and  $a_{21}$  units of Factor 2. These  $a_{ij}$  values reveal the constant factor input proportions in producing output by that process. Their graphic representation gives us the production or process ray and reminds one that the assumption of constant returns to scale has been made. Similarly, by Process 2 a unit of output would use  $a_{12}$  units of Factor 1 and  $a_{22}$  units of Factor 2.

In the numerical example the  $a_{12}$  value was 1 and the  $a_{22}$  value was 3 as seen in (6) and (7). Thus the slope of the Process 2 ray was 3. For each unit

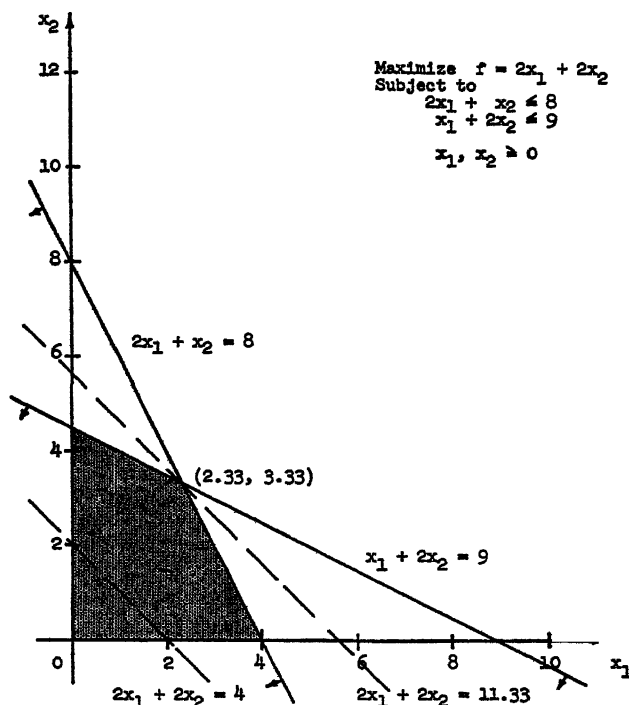


FIGURE 7

of output produced by Process 2, 1 unit of Factor 1 was used and 3 units of Factor 2 were used. Now consider a technological change which might be considered a modification of Process 2. Say that it results in a change in  $a_{22}$  from 3 to 2 in (7). This changes the slope of the ray from 3 to 2 and in effect creates a new process ray. The effect of the technological change can now be observed in Figures 7 and 8. The optimal output is now 5.67; the optimal program is:  $x_1=2.33$ ;  $x_2=3.33$ ; and total profit is \$11.33. The change increased total profit by \$1.33.

By increasing the number of process rays one can approach the familiar isoproduct curves of standard marginal analysis and thus begin to observe the essential unity of the two approaches. The linear programming approach, at times, has some advantages in view of (a) the difficulty of obtaining marginal data in practical problems, (b) the existence of choice in producing many different products or engaging in many different activities, and (c) the existence of efficient computational methods and modern electronic computing equipment. In addition to the provision of efficient solution algorithms for linear programming problems several computer manufacturers have computer programs which permit individual parameter variation of the  $b_i$ , the  $c_j$ , and the  $a_{ij}$ ; simultaneous parameter varia-



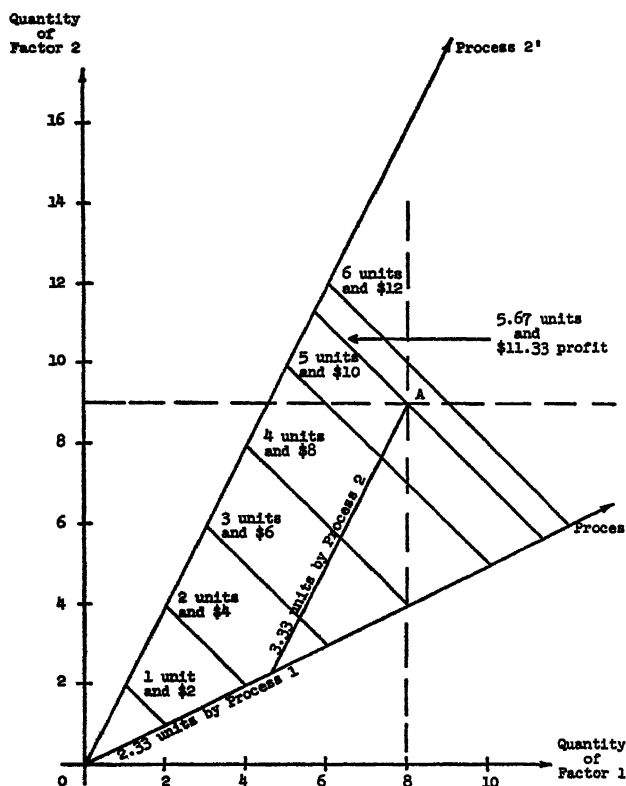


FIGURE 8

tion of the  $b_i$ , and the  $c_j$ ; and simultaneous variation of the  $b_i$ , the  $c_j$ ; and the  $a_{ij}$  (the latter one row or column at a time).

Useful discussions on the exploration and analysis of linear programming problems are given by Spivey [12, pp. 166-80], Hadley [10, pp. 379-95], Garvin [8, pp. 49-61, 220-31], Dantzig [4, pp. 265-75], and Gass [9, pp. 123-41].

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## The Average Level of Schooling and the Intra-Regional Inequality of Income: A Clarification

### I. Introduction

In the March 1967 issue of this *Review*, A. Al-Samarrie and H. P. Miller [2] and D. J. Aigner and A. J. Heins [1] attempt to explain state-to-state variations in income concentration by means of cross-sectional multiple regression analysis for the United States. Aigner and Heins indicate that their purpose is "to report further evidence of the tendency for the personal income of a region to be more equally divided the more maturely developed is the region" [1, p. 175]. Al-Samarrie and Miller conclude that the level of education is "highly [inversely] correlated with income concentration" [2, pp. 61 and 71]. Simon Kuznets examined international and interregional data and reported that countries and regions at a lower level of income tend to have a greater income inequality [8] [9]. The conclusions of these and other writers support the commonly held view that the distribution of income is more equal the higher the level of income or schooling in a region.<sup>1</sup>

Aigner and Heins state that "there is no formal theory available which satisfactorily concerns itself with the relationship between development and the inequality of incomes" [1, p. 176]. They also indicate that they have nothing more than a "naive theory" for relating their variable for level of schooling (which they use to "describe the basic skill level of each state population") to income inequality [1, pp. 177-78].<sup>2</sup>

I have two purposes in writing this note. I wish to show that a specific theory, the theory of investment in human capital, may be used to demonstrate that, across regions, the level of schooling can be related to income

<sup>1</sup> This view is so common among economists that it is frequently expressed in textbooks on economic principles without qualifications. For example, see P. Samuelson [11, p. 111, note to figure 6-3(a)].

<sup>2</sup> Kuznets indicates that we lack "a firm set of links between the observable changes in the production structure that constitute economic growth and the observable *associated* changes in the income distribution" [9, p. 2]. In his discussion of the relationship between the level and inequality of income there is an absence of an explicit consideration of the effect of training or schooling on the distribution of income [8] [9].

inequality and that, *ceteris paribus*, this relation is positive.<sup>3</sup> I will also demonstrate that the observed negative simple correlation for the states of the United States may be related to the omission of two variables that are relevant to the determination of income inequality. These variables are the average rate of return from schooling and the inequality in the distribution of years of schooling attended.

A model is presented in section II in which relative income inequality is related to the levels and inequalities of years of schooling and rates of return from schooling. This model is employed in section III to ascertain the relation between income inequality and the average level of schooling for the states of the United States when the rate of return and schooling inequality are held constant. The relationships among the schooling and income parameters are discussed in section IV. Section V contains the conclusions of this note.

## II. The Model

On the basis of an earlier article (with different notation) in this *Review* [4], it can be shown that if, for the  $i$ th person,  $Y_{s,i}$  were income after  $S_i$  years of investment in schooling,  $\bar{Y}_0$  were the average zero schooling level of income,  $r_i$  were the adjusted rate of return from schooling,<sup>4</sup> and  $U_i$  were the residual, then approximately,

$$(1) \quad \text{Ln } (Y_{s,i}) = \text{Ln } \bar{Y}_0 + r_i S_i + U_i.$$

For simplicity, let us neglect the residual  $U_i$  and assume that all income above  $\bar{Y}_0$  is due to investments in training. Then, if we calculate the variances of both sides of equation (1), we obtain

$$(2) \quad \text{Var } (\text{Ln } Y_i) = \text{Var } (r_i S_i),$$

where Var means variance. The relative variance of income depends on the absolute variance of the product of the adjusted rate of return and the number of years of schooling. The variance of the natural logarithm of income is a commonly used measure of income inequality.

The variance of a product of two independent random variables,  $r_i$  and  $S_i$ , can be expressed as [7]

$$(3) \quad \text{Var } (r_i S_i) = \bar{r}^2 \text{Var } (S_i) + \bar{S}^2 \text{Var } (r_i) + \text{Var } (S_i) \text{Var } (r_i).$$

Thus, if  $r_i$  and  $S_i$  were independent, the relative variance of income would be positively related to the average level and the variance of each variable.

It is not likely that, in a region, the rate of return to individuals and their level of schooling are independent [4]. The variance of a product of two variables that are not independent can be evaluated [7], but this is not needed for the present purpose. The preceding implies that, *ceteris paribus*, the

<sup>3</sup> Mincer [10] has shown that, within regions, income inequality increases with higher levels of occupation, schooling, and age.

<sup>4</sup> For each individual,  $r_i$  is the average rate of return from his investment in schooling adjusted for the average fraction of earnings foregone during the period of investment [4, pp. 363-64].

intra-regional relative inequality of income would be positively related to the average levels and the variances of both years of schooling and rates of return from schooling even if, for individuals, levels of schooling and rates of return were not independent.

### III. Interstate Analysis

Although many average internal rates of return from schooling have been estimated in recent years, no such calculations have been made for the states. I have calculated [5, Chs. 2 and 3] regression estimates of rates of return from schooling for the 51 states for adult "white males" using the

TABLE 1—MATRIX OF CORRELATION COEFFICIENTS FOR THE STATES<sup>a</sup>

	Var (Ln $Y$ )	$\bar{r}$	Var ( $S$ )
$\bar{r}$	.835		
Var ( $S$ )	.490	.316	
AV ( $S$ )	-.161	-.369	-.208
	<i>Probability<sup>b</sup></i>	<i>R</i>	
	.050	.231	
	.025	.273	
	.010	.322	

<sup>a</sup> Ln  $Y$  = natural log of income

$\bar{r}$  = regression estimate of the average adjusted rate of return from schooling

$S$  = years of schooling attended

Var = variance

AV = average

<sup>b</sup> The probabilities represent the chance that sample estimates of the correlation coefficients ( $R$ ) will be greater than the values given. The probabilities are based on 50 degrees of freedom.

Sources: [12, Pts. 2-52, Table 138] and [5, Ch. 3, Tables I-1, I-2].

1960 Census of Population [12, Table 138].<sup>5</sup> The average levels and variances of schooling for the states have been calculated from the same source. As of the present, no estimates exist for the inequality of rates of return within states.

Table 1 presents simple correlation coefficients for adult white males in the states. The average rate of return ( $\bar{r}$ ) and schooling inequality (Var( $S$ )) are significantly (at a one per cent level) positively correlated with income inequality. The level of schooling is negatively correlated with the inequality of income. This last correlation is consistent with the empirical findings of other studies [1] [2] [4] [8] [9].

Note, however, that the average level of schooling is negatively correlated with the estimated average rate of return and the inequality of schooling. What would be the relation between average level of schooling and income

<sup>5</sup> The District of Columbia is considered a state. "White males" means that nonwhites were excluded from 17 states—the 16 states in which nonwhites constitute 10 per cent or more of adult males plus New York.

TABLE 2—REGRESSION RESULTS FOR THE STATES<sup>a</sup>  
Dependent Variable: Var (Ln Y)

Explanatory Variable	Coefficient	Student's <i>t</i> Ratio
AV ( <i>S</i> )	0.033	2.734
<i>r</i>	6.945	10.961
Var ( <i>S</i> )	0.012	3.822

<sup>a</sup> For notation and definitions, see Table 1.

Sources: Same as Table 1.

inequality if we held constant both the average rate of return and schooling inequality?

Table 2 contains the results from a multiple linear regression of the variance of the log of income on the average level of schooling, the average rate of return, and schooling inequality. The partial slope coefficient of each of the three variables is significantly positive at a one per cent level. These results are consistent with the hypothesis derived from the model in section II which relates income inequality to schooling.

#### IV. Relationships Among the Parameters

The signs of the correlation coefficients among the average level of schooling, the average rate of return, and the inequality of schooling are not clear a priori. The average rate of return is largely determined by average supply and demand conditions for funds for investment in human capital.<sup>6</sup> The inequality of schooling depends primarily on the inequality in these conditions within the region.<sup>7</sup> It is not clear that the level and inequality of the supply and demand conditions for funds need be related.<sup>8</sup>

If economic growth resulted in changes in only the demand conditions for human capital, there would be a rise in the rate of return and the level of schooling. However, the increases in wealth and the improved capital markets associated with economic growth would lower the cost of funds for investment in human capital, and this would raise the average level of schooling but decrease the average rate of return from schooling. Thus, the effect of economic growth on the rate of return is ambiguous.

The low level of income and the less perfect capital markets of less developed regions increase the rate of return. If inter-area migration did not exist, the smaller demand for human capital by less developed regions

<sup>6</sup> The level and the elasticity of the average supply curve for funds for investment in human capital largely depend on the level of wealth in the economy and the stage of development of the capital market. The level and the elasticity of the average demand curve for funds are, in part, derived from the demand by the economy for human capital and the average level and elasticity of ability.

<sup>7</sup> The inequality in the supply conditions for funds depends primarily on differences in individual wealth and access to funds, while the inequality in demand conditions depends largely on differences in ability.

<sup>8</sup> Although the average rate of return and schooling inequality are significantly positively correlated for all of the states (for all males and white males only), they are uncorrelated for the states of the South and white non-South and significantly negatively correlated for the states of the non-South and white South [5, Ch. 3 and Table F-1].

would lower the rate of return. Labor markets are more national and international in scope the higher the level of schooling. This tends to produce a negative relation between the average level of schooling and the average rate of return.<sup>9</sup> Although the sign of the net effect is indeterminate, the algebraic value of the correlation coefficient between the average level of schooling and the average rate of return would be lower the greater the relative interregional mobility of skilled labor.<sup>10</sup> Indeed, migration may generally result in a negative correlation across the regions of a country.

The effect of changes in either the supply or the demand conditions for human capital on schooling inequality depends on which parts of the distribution of schooling increase their level of schooling. The coefficient of variation of years of schooling,  $[\text{Var}(S)/S^2]^{1/2}$ , seems to decline with the rise in the level of schooling associated with economic growth, but it is not clear whether the variance of years of schooling increases or decreases.<sup>11</sup>

Thus, there appear to be no a priori reasons, nor consistent empirical findings, for expecting the average level of schooling to be negatively related to the inequality of schooling, nor for expecting a positive relation between the latter parameter and the average rate of return. The average level of schooling and the average rate of return may tend to be negatively correlated among regions for which there is much mobility of skilled labor.

Since it appears that the rate of return is more powerful than the level of schooling in explaining income inequality [5, Chs. 3 and 4], a negative correlation between the level of schooling and the rate of return would result in a negative simple correlation between the level of schooling and the inequality of income. Thus, it is consistent with economic analysis for the level of schooling and the inequality of income to have a positive partial but a negative simple correlation across the regions of a country. The level of schooling and the rate of return are less likely to be negatively correlated across countries than across sections of a country, and, therefore, it is less likely that a negative simple correlation between the level of schooling and income inequality would appear in an international analysis.

### V. Conclusions

*Ceteris paribus*, the higher the average level of schooling in a region, the greater the inequality of income in that region. If simple correlation coefficients are examined, other variables (in particular, the average rate of return) may produce a negative simple correlation.

<sup>9</sup> Empirical studies for the United States indicate that rates of migration across states tend to increase with higher levels of schooling [3, p. 89 note] [6]. The greater relative mobility of educated workers is due, in part, to the components of the information and migration costs which are largely independent of the level of schooling.

A higher rate of migration for educated workers depresses the average rate of return from training in the area of in-migration (an area with high levels of income and schooling) and increases the average rate of return in the area of out-migration (an area with low levels of income and schooling).

<sup>10</sup> This may explain the significant negative correlation between the average rate of return and the average level of schooling in Table 1.

<sup>11</sup> Although the correlation between level and inequality of schooling is negative in the United States, it is positive for the provinces of Canada and the regions of the Netherlands [5, Ch. 3 and Table F-1].

The greater the relative mobility of those with higher levels of schooling, the larger is the negative correlation between the average level of schooling and the average rate of return, and, thus, the greater is the likelihood of a negative simple relation between the average level of schooling and income inequality. It is not surprising, therefore, that the average level of schooling and the inequality of income have a negative simple and a positive partial correlation across the states of the United States. We would expect a similar pattern to appear across the regions of other countries, but it is less clear that such a pattern exists in cross-sectional international data. It might be useful to perform an international analysis if the relevant data were available.

The changes in the distribution of schooling associated with economic growth are likely to result in an *increase* in income inequality, since the average level of schooling increases, and even if schooling inequality were to decline, its decline would tend to be small.

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### The Degree of Moneyness of Savings Deposits

The postwar period has been characterized by two important changes in the liabilities of nonmonetary intermediaries. First, the liabilities of these institutions have grown at a faster rate than the liabilities of commercial banks. For example, mutual savings deposits have increased from \$16 billion in 1946 to \$54 billion in 1966. Savings and loan share capital increased from \$8 billion to \$111 billion during the same period. On the other hand, total commercial bank deposits increased from \$112 billion to \$288 billion during the same period. Second, since 1950 the insurance provisions applicable to savings and loan shares were revised and made comparable to those applicable on commercial bank deposits insured by the FDIC. The rapid growth of the liabilities of the intermediaries has raised an important issue concerning the degree to which these liabilities can be substituted for money. Gurley and Shaw [1, 2, 3], after an elaborate examination of the role of nonmonetary intermediaries in the economy, maintain that the liabilities of these institutions are close substitutes for money and that the rapid growth of these liabilities in recent decades has had the effect of reducing the demand for money. However, recently Timberlake and Fortson [4] used a test for analyzing the degree of moneyness of time deposits and found that except for the period 1933-38, time deposits lacked moneyness.

In view of the fact that the quantitative and qualitative changes in the liabilities of nonmonetary intermediaries have occurred in the postwar period, it was decided to focus attention on this period. In the following analysis, the Timberlake-Fortson technique is used to test the degree of moneyness of diverse stocks of savings deposits using quarterly data for the period 1947 to 1966. The concepts used in the analysis are defined as follows:

$Y$  = Consumption + net private domestic investment + net foreign investment + government deficit on income and product account.

$M$  = Currency outside banks + demand deposits adjusted.

$S_1$  = Commercial bank time deposits.

$S_2 = S_1$  + mutual savings deposits + postal deposits.

$S_3 = S_2$  + savings and loan share capital.<sup>1</sup>

It may be pointed out that the above definition of money income,  $Y$ , corresponds to the one used by Timberlake and Fortson, and the savings deposits variable used by them corresponds to our  $S_2$ . To test the degree of moneyness of savings deposits, multiple regression analysis is employed using first differences in  $M$  and in the relevant stock of savings deposits, to predict changes in income,  $Y$ . For testing the relationship, the following formulation suggested by Timberlake and Fortson is used:

$$\Delta Y = a + b\Delta M + c\Delta S \quad (i)$$

<sup>1</sup> The decision to broaden the savings deposits variable,  $S_2$ , to include savings and loan share capital was prompted by the fact that for practical purposes it appears that savings and loan shares are similar to time deposits in commercial and mutual banks.



or

$$\Delta Y = a + b \left[ \Delta M + \frac{c}{b} \Delta S \right] \quad (\text{ii})$$

where  $S$  represents the relevant savings deposits variable. If savings deposits have some degree of moneyiness, the ratio  $c/b$  would be greater than zero but less than one. If the value of  $c/b$  equals one, savings deposits may be said to have the same degree of moneyiness as the items in  $M$ .

The results presented in Table I show that all three stocks of savings de-

TABLE 1—MULTIPLE LINEAR REGRESSION EQUATIONS BETWEEN FIRST DIFFERENCES IN  $Y$  AND FIRST DIFFERENCES IN  $M$  AND  $S$ . QUARTERLY FIGURES, 1947 (II)—1966 (IV)

Number	Dependent Variable	Constant	$b$ Regression Coefficient of $\Delta M$	$c$ Regression Coefficient of $\Delta S_1, \Delta S_2, \Delta S_3$	$c/b$	$R$
1	$\Delta Y$	2.7597	1.1866 $\Delta M$ (0.5358) [0.2463]	0.6865 $\Delta S_1$ (0.3038) [0.2509]	0.5785	.4280
2	$\Delta Y$	2.6695	1.2017 $\Delta M$ (0.5373) [0.2485]	0.5766 $\Delta S_2$ (0.2646) [0.2425]	0.4798	.4237
3	$\Delta Y$	2.4431	1.2508 $\Delta M$ (0.5313) [0.2608]	0.4054 $\Delta S_3$ (0.1914) [0.2360]	0.3241	.4206

*Note:* Figures in parentheses are standard errors of respective regression coefficients, and figures in brackets are partial correlation coefficients.

*Sources:* Data for  $Y$  from 1947 to 1964 were taken from *Survey of Current Business*, Aug. 1965, Table 1, pp. 24–25, Table 4, pp. 30–31, Table 5, pp. 32–33, Table 6, pp. 34–35, Table 8, pp. 36–37, Table 10, pp. 38–39; and for the period 1965–66 from current issues of the *Survey*. Data for  $M$  and  $S_1$  from 1947 to 1963 were taken from *Fed. Res. Bull.*, June 1964, pp. 682–92, and for the period 1964–66 from current issues of the *Bulletin*. Data for mutual savings and postal deposits from 1947 to 1960 were taken from M. Friedman and A. J. Schwartz, *A Monetary History of the United States, 1867–1960*, Princeton, 1963, pp. 718–22, and supplemented to 1966 from current issues of *Federal Reserve Bulletin*. Data for savings and loan share capital from 1947 to 1966 were obtained from the Office of Research and Home Finance, Federal Home Loan Bank Board, Washington, D.C.

posits possess significant degrees of moneyiness. It can be seen from (1) that for commercial bank time deposits,  $S_1$ , the value of the ratio,  $c/b$ , equals 0.5785. This ratio decreases to 0.4798 in (2) and to 0.3241 in (3) for  $S_2$  and  $S_3$  concepts of savings deposits respectively. Thus the evidence shows that as we broaden the concept of savings deposits, the degree of moneyiness decreases. However, we may note that all regression and partial correlation coefficients are significant at the 5 per cent level.<sup>2</sup>

<sup>2</sup> The values of the multiple and partial correlation coefficients may not seem very high, but it should be remembered that the data used in the analysis are quarterly first differences. See the discussion on this point by Friedman and Meiselman. [5, pp. 203–4.]

We may note, too, that for the Timberlake-Fortson savings deposits variable which corresponds to our  $S_2$ , the degree of moneyiness is 0.4798.<sup>3</sup> They have shown that except for the 1929-39 decade (which includes their estimate for the period 1933-38) savings deposits,  $S_2$ , possessed negative degrees of moneyiness in the prewar period. Using the same method we have shown that in the postwar period all three stocks of savings deposits possessed varying degrees of moneyiness. Estimates of savings deposits  $S_2$ , and  $S_3$ , which contain the liabilities of nonmonetary intermediaries, though possess lower degrees of moneyiness than  $S_1$ , are statistically significant. The evidence presented above substantiates the Gurley-Shaw hypothesis and is in line with the findings of Lee [6].

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### On the Economics of Wired City Television

Let us assume that the Federal Communications Commission authorized the development of wired cities for television (WCTV), whereby programs would be carried to homes on wires, as telephone calls are. The system would eliminate television towers and broadcast transmitters, home antennas and leads, possibly a portion of the TV set, and the use of electromagnetic spectrum which the signal occupies over the city. But the new system would require a single street wire and individual drop lines to homes.

We would expect various companies, existing ones and newly formed, to apply to the local governmental authorities for a common carrier franchise to

<sup>3</sup> Since Timberlake and Fortson did not estimate the degree of moneyiness of  $S_2$  for the period covered above, it is not possible to compare results. However, they did make estimates (using annual data) for the period 1948-1960 and 1953-65 for which they found  $c/b$  values of -.3032 and .1521 respectively.

wire up the cities with 20-TV channel coaxial cable. Governmental utility corporations might propose to extend their utility services already provided—electricity, telephone, transit, water, etc. Among private companies, CATV firms are already in the business of wiring up cities. So are telephone and electric companies. Gas and water companies and other firms might also be interested.

The single 20-TV channel coaxial wire carried throughout the city is the same type that CATV now uses in its 12-TV channel systems.<sup>1</sup> There is a drop line to each home, at the end of which is a terminal for plugging in present (and future) TV sets. TV guides are available from the WCTV company and, as now, with newspapers or by subscription from a publisher. In addition to the wire network, the common carrier system also provides as an optional service rental studios, cameras, tape recorders and players, and studio personnel. Similarly, rental switching facilities are available for receiving microwave, satellite, wire, or wave guide relays from elsewhere, and putting them onto the wired city system.

The common carrier will put any sender's signals on the wire, charging him according to published tariffs approved by the regulatory authority. Senders may lease a TV channel by the year, by the month, by the day, by the hour; or by the half hour per week, for a year; or in any other way, subject to availability and tariff. Senders could use their own studios, or they could rent studios, cameras and crews, etc. If more channels are required, they will be provided in due time, following usual common carrier procedures.

We now consider the various sources of television programs:

1. *Television stations with advertiser sponsors.* These would operate the same as present stations, except that their programs would be sent on the wire instead of over-the-air from a transmitter on a tower. Stations would have to pay an annual lease charge, but this cost would be relatively small (see below).

2. *Pay TV.* This could be provided by entertainment companies which, for a subscription fee, would provide programs. The public now buys season or series tickets for plays, concerts, and ball games; subscribes to magazines and to newspapers; etc. Presumably, some would subscribe to pay TV. An entertainment company would lease a channel from the common carrier for the appropriate period—for example, 24 hours per day, 365 days; or, say, Sunday afternoons during winter months. There could be several series—subscription A, subscription B, single programs, etc. To prevent nonsubscribers from viewing, a coding or scramble device could be used; or the common carrier, for a fee, could install a blackout device to interdict the program at the dropline; or a meter could be installed which recorded times spent viewing the pay TV channels.

3. *Politicians* would seek access to a TV channel for individual time periods. They could buy time from the commercial stations. Or other business enterprises would develop whose specialty was leasing blocks of time and retail-

<sup>1</sup> For more detail on CATV systems, see [1] - [4].

ing political and other one-shot broadcasts. Or political parties could lease for periods. Or the politician could simply rent time and studio facilities directly from the common carrier. Further, his coverage could be limited to his own constituency.

4. *Educational TV (ETV)* would send programs on the wire. Preschool children would undoubtedly be offered instructional programs, as would students confined to their homes. So-called public TV would also be offered. The Carnegie Report on Public Television recommends that the United States have about 380 ETV stations (connected by intercity relays). The city could require, as a franchise condition, that one or two such channels be provided free on the common carrier's 20-channel cable; or ETV could lease the channels.

5. *Network program.* Networks could continue to operate as now through affiliated stations, which share in the network revenue received from advertisers. Or, subject to FCC rules, it would be possible for networks to lease their own channels on the wire. There would be opportunity for more networks because of the increase in local channel outlets and the lower cost to reach the audiences. Supplementing the benefits of increase in local channels and the reduction in cost to use them is the fact that intercity relay charges—and, indeed, intercontinental relay charges—will decline steeply with development of television satellites and wave guide. It is likely that a large increase in network and foreign programs would develop.

In brief, a system of wired cities would be able to provide more, and more diverse, programming than does the present system or the major alternative possibilities.

We compare the present system with the proposed new one:

<i>Item</i>	<i>Present System</i>	<i>Proposed WCTV</i>
Spectrum	Uses 1 TV channel per station	None
Transmitter and tower	Uses 1 per station	None
Home antenna	Uses 1 per home	None
Home sets	One or several per home	One or several per home; some cost saving in the chassis
Poles, conduits, droplines	Doesn't use for TV	One coaxial wire on pole or in conduit, plus 1 drop wire per home

The proposed system is advantageous on the first four lines. It has a cost disadvantage on the last line. We estimate that the street cable and droplines of the wired cities would require a total capital investment figure of about \$60 a home.<sup>2</sup> This would justify a basic common carrier toll for the 20-channel capacity equivalent to about \$1 to \$1.50 a month charged to either the customer, or the sender, or both parties in combination.

What are the benefits which might justify this investment cost of, say, \$60 a home for wiring the city? We summarize below:

<sup>2</sup> This estimate is based on the experience of CATV systems; see [1, pp. 12-17] [4, pp. 23-40].

1. *Number of channels.* The initial installation of 20-TV channel coaxial wire is a very large increase in potential service. Most TV markets are now served with about three commercial and educational TV signals, and even if all the new UHF assignments were activated, the figure would average only five or less. Wired city television breaks through the present limitation on TV channels due to limited spectrum assignments for television. Alternatives such as pay TV, or a flourishing UHF system, or regulation of networks, or direct broadcasting from satellites do not escape this limit.

2. *Cost, numbers, and diversity of offerings.* The cost to carry a signal to the home would become extremely low under the WCTV proposal. At these low costs, there will be a sizeable increase in number and diversity of programs offered. A major financial barrier to entry, high marginal cost for transmission on an additional channel, would be overcome. At the low transmission costs and with open time available, minority-taste audiences could be served with the specialized TV fare they desired, either because they would pay for it themselves or because someone else was willing to pay in order to deliver the program or its related messages. Diversity and wider consumer choice would be provided.<sup>3</sup> Opportunities to watch programs with little or no advertising would develop, for those with this preference. Television time for politicians would no longer be restricted to candidates with large financial means or rich sponsors. Moreover, these favorable results for communication freedom would occur without governmental controls on programs or scrutiny of political speakers.

3. *Picture quality.* The wire system would serve uniformly excellent pictures on all channels on sets of present quality, because the signal would be stronger and interference negligible. Beyond this, there would be opportunity for vastly greater improvements in picture quality—size, resolution, definition, colors—from use of improved wire and completely redesigned and improved TV sets; these would, however, require additional costs.

4. *Cost savings for homes and broadcasters.* To offset the cost of creating the wire system, estimated at \$6,000,000 for a city of 100,000 homes, there will be cost reductions to homes and broadcasters. One saving to homes would be the elimination of antennas. If we assume that all the homes have antennas for color or UHF sets, this saving is approximately equal to the entire cost of wiring the city! The fact is that an outside antenna for color TV and UHF costs as much or more per home as the cost per home of the wired city. In addition, new color sets and possibly new black and white sets for wire TV would become cheaper from eliminating the TV set elements which are related to picking up and handling the weaker, less clean, over-the-air signals. As color sets become widespread, about \$30,000,000 or more of TV sets would be involved in a city of 100,000 homes. The cost saving on these might be half as much as the \$6,000,000 cost of wiring the city, or possibly as much as that cost. There would be, in addition, savings in annual maintenance charges due to the elimination of these set elements. Finally, stations would save the

<sup>3</sup> For the view that an increase in the number of signals leads to an increase in diversity, see [1, pp. 1-3] [5].

\$100,000 to \$200,000 per year which they pay for capital and operating charges on a tower and transmitter.

In summary, capital savings to offset the \$6,000,000 capital cost of wiring a city of 100,000 homes are considerable:

	<i>Savings in Capital Cost</i>
Home antennas for color sets, at \$60 per home	\$6,000,000
Home sets, saving of 20 per cent on 50,000 color sets, at \$300 each	3,000,000
Transmitters and towers, about \$500,000 each channel	?

5. *Spectrum saving.* It is generally believed that there is a shortage of spectrum. Television now utilizes a very large fraction of the spectrum, in the best frequencies. Wire television could permit some of the spectrum now allocated to TV to be assigned to other valuable purposes, such as for public safety, use by land and marine mobiles, in satellite relays, etc.

6. *Flexibility.* Finally, the wired city provides flexibility for further communication innovations. The initial coaxial wire can provide extra channels, which could be made available at nil or nominal charge to sponsor innovations. These could lead ultimately, to shopping services; credit purchases; facsimile mail; data processing, bookkeeping, and reference services; etc. A wire system is, of course, indefinitely expandable.

We conclude by considering a few objections and obstacles to the introduction of a wired-city television system. First is the problem of service to rural areas, where wiring may be very expensive per home. In such places it may be necessary to continue to use an over-the-air system, but more accurate cost estimates, new or improved technology, translators, or some form of subsidy might allow rural areas full benefits of a wired system. Second, in very large, densely populated areas, such as New York City, broadcasting over-the-air is a cheaper means of transmission than wire up to the limit of available spectrum. This comparison may mislead, however, because over-the-air transmission: (i) gives lesser picture quality, (ii) utilizes scarce spectrum space, and (iii) requires relatively greater consumer investment. Third is the problem of programming costs, which some believe may be so high as to prevent utilization of a 20-channel system. We differ. With a large number of channels the opportunity costs of repeating programs a few times a week would be much lowered, thus permitting lower costs and increasing the public's effective choice. As it becomes possible to reach more specialized tastes, then local, regional, and foreign talent and programs will be utilized which are not in great demand now or even used at all, and therefore do not command high unit prices. Compare, for example, magazines, books, and the diversity of types and levels of theater. Inexpensive, service type programming will appear—weather reports, city council meetings, stock market reports, community affairs, and news tickers—when the opportunity cost of channel use declines. As many channels of programs will become available as there is willingness to pay; and the marginal costs can be exceedingly low.

Finally there are the political realities. The networks and stations have extremely desirable oligopoly positions at present. They have numerous financial and political allies in the Congress. Stations are closely associated with major newspapers. Other communications media, including motion picture exhibitors, who previously led a successful attack on pay-TV in California, might experience audience loss from improvement in volume, diversity, and picture quality of TV. Other obstacles could be mentioned. Yet the promise and potentials of wired city television and other wired city services are so extraordinary that ultimately we may have them.

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\*The authors are faculty members of the Department of Economics, Washington University, and consultants to RAND Corporation. A much more extended version of the paper was presented at the Resources for the Future-Brookings Conference on Use and Regulation of the Radio Spectrum [1]. The Conference proceedings and papers have been published in the *Washington University Law Quarterly*, Fall 1967 and Winter 1968. The expressions herein are personal views, and not necessarily those of RAND or its staff members, to whom we are grateful for assistance.

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### The Contribution of Education to the Quality of Labor 1929-1963

Greater education of labor, E. F. Denison has estimated, increased output per man-hour in the United States between 1929 and 1957 by one-third. Denison ascribes over three-fifths of the growth in output per man-hour to increased education [1, p. 148], and largely because of this estimate he is able to keep the unexplained residual in the growth of man-hour productivity down to a little more than one-half. This paper presents an estimate of education's contribution to the increase in labor productivity between 1929 and 1963 that is far below Denison's. The major source of the difference is in the measurement of the effect of education on earnings, which is the index of the quality of labor. The other, much less important, source of disagreement between the estimates is in the measurement of the change in the level of education over the years.

### I. *The Procedure for Estimation*

Measurements of the quality of labor that rely on socio-demographic characteristics, including Denison's, employ an index similar to the one described by the following formula:

$$L_t/L_0 = \frac{a \sum_i n_{it} w_i}{\sum_i n_{i0} w_i}$$

where

$n_i$  = number of workers in socio-demographic group  $i$ ,  
 $w_i$  = average earnings of members of group  $i$ ,  
 $a$  = adjustment factor for ability, and  
 $t$  and  $o$  are time subscripts.

My estimate relies on measurements which differ from those underlying Denison's. To measure  $w_i$ , I use average hourly earnings of employed persons cross-classified by age, sex, and years of schooling, and the sample excludes agricultural workers, the unemployed, and those not in the labor force. Denison's estimate of education's contribution is based on average annual incomes of all males between the ages of 25 and 64 years classified by years of schooling [1, p. 67]. In addition, I give additional days per year of schooling less credit than the same number of days represented by additional school years. Denison, on the other hand, measures education in units of school days [1, p. 71].

My assumption concerning the effect of ability on education differentials in earnings is the same as Denison's. He proposed that 40 per cent of any education differential in earnings be assigned to ability [1, p. 73], and I have accordingly set  $a$  equal to .6.

### II. *The Estimate*

The values of  $w_i$  in the formula for  $L_t/L_0$  are average hourly earnings of nonagricultural employed persons in 1959 classified by age, sex, and education (Table 1), which V. R. Fuchs derived from the 1/1,000 sample of the 1960 Censuses of Population and Housing. The Census data on hours were for a week in 1960, the earnings data were for the entire year 1959, and the number of weeks worked in 1959 was reported. The number of hours worked during the week in 1960 was used as an estimate of average weekly hours in 1959, and this estimate times the number of weeks worked in 1959 yielded the estimated total annual hours in 1959. The ratio of annual earnings to annual hours was the estimate of average hourly earnings. The estimate was based on a sample which excluded persons reporting no earnings in 1959, and persons reporting no hours worked in the week in 1960 for which the hours data were obtained. The sample also excluded agricultural workers because their total earnings tend to be underestimated. Income in kind is a large fraction of total earnings and the importance of self-employment



TABLE 1—AVERAGE HOURLY EARNINGS OF EMPLOYED PERSONS IN NONAGRICULTURAL INDUSTRIES BY SEX, AGE, AND YEARS OF SCHOOLING BASED ON ANNUAL EARNINGS IN 1959 AND HOURS DURING A WEEK IN 1960

Age	Years of Schooling						Total
	0-4	5-8	9-11	12	13-15	16+	
<i>Males</i>							
14-19	0.92	1.46	1.42	1.38	1.63	—	1.41
20-24	1.42	1.58	1.72	1.87	2.05	2.26	1.84
25-34	1.63	2.11	2.36	2.53	2.75	3.26	2.56
35-44	1.81	2.36	2.71	2.99	3.45	4.66	3.04
45-54	1.82	2.47	2.74	3.13	3.99	5.29	3.09
55-64	1.91	2.47	2.88	3.30	4.13	5.10	2.96
65+	1.83	2.22	2.76	3.60	3.58	5.08	2.83
Total	1.80	2.32	2.52	2.74	3.28	4.27	2.79
<i>Females</i>							
14-19	1.14	1.29	1.48	1.28	1.31	0.74	1.34
20-24	1.25	1.04	1.37	1.53	1.64	2.12	1.54
25-34	1.27	1.27	1.55	1.73	1.95	2.53	1.74
35-44	1.16	1.33	1.52	1.81	2.06	2.76	1.74
45-54	0.94	1.34	1.59	1.81	2.19	3.00	1.77
55-64	1.15	1.41	1.51	1.86	2.24	3.05	1.75
65+	1.06	1.13	1.50	1.81	1.59	2.66	1.49
Total	1.09	1.32	1.53	1.72	1.99	2.75	1.70

Source: V. R. Fuchs, [2, Table A-1, based on *U. S. Censuses of Population and Housing: 1960, 1/1,000 Sample*]. The sample includes all persons who were at work in nonagricultural industries during the Census week (early April) in 1960, and reported some earnings in 1959. Persons with a job but not at work in the Census week were excluded because no estimate could be made of their weekly hours. Actual average hourly earnings in 1959 were estimated from annual earnings in 1959 divided by number of weeks worked in 1959 and number of hours worked in the Census week of 1960.

also contributes to error. Since the error is to understate earnings, and both average earnings and education level are low, an estimate based on earnings of all employed persons would exaggerate the gains from education.

Data on years of schooling were provided by the Census of Population for 1940 for the experienced labor force, including unemployed persons, but excluding workers employed on public emergency projects. The estimated change in educational level relies on a comparison between the experienced labor force in 1940 and employed persons in 1960. The change in the definition of labor exaggerates the increase, since unemployed persons on the average have less education than employed persons. Table 2 compares the distributions of persons by years of schooling in the two years.

The first step was to obtain an estimate of the increase in quality per worker attributable to education measured in years of schooling. Between 1940 and 1960 the increase in the number of school years improved the quality of labor by 4.0 per cent. An assumption that the rate of change was uniform over the entire period 1929 to 1963 results in an estimated gain of 6.8 per cent.

Since the average number of days per school year completed by workers increased by approximately the same percentage as the number of school years, the index of improvement in quality due to education measured in school days is the square of the index based on school years, or 1.068.<sup>3</sup> This results in an estimated improvement of 14.1 per cent. The gain in quality thus is between 6.8 per cent and 14.1 per cent depending upon the importance attached to the number of days per school year. I will assume that an additional day of schooling is equivalent to 70 per cent of any day included in an additional year. This assumption yields an estimated improvement in

TABLE 2—PERCENTAGE DISTRIBUTION BY YEARS OF SCHOOLING OF THE EXPERIENCED LABOR FORCE IN 1940 AND OF EMPLOYED PERSONS IN 1960

Years of Schooling	1940		1960	
	Males	Females	Males	Females
Total	100.0	100.0	100.0	100.0
0-4	11.8	7.4	5.9	3.5
5-6	10.3	7.3	12.3	8.9
7-8	33.4	24.5	15.8	12.7
9-11	17.1	17.8	22.2	22.5
12	16.2	27.6	24.4	33.3
13-15	5.5	8.7	9.6	11.1
16+	5.7	6.7	9.7	7.9

Source: 1940: *Sixteenth Census of the U.S.: 1940*, Population The Labor Force (Sample Statistics), Occupational Characteristics, Table 3. 1960: *U.S. Census of Population: 1960*, Occupational Characteristics, Table 9.

quality of 11.9 per cent, which is equivalent to an average annual rate of increase of .3 per cent.

### III. Comparison with Denison's Estimate

Denison's estimate of the contribution of education to the increase in quality of labor between 1930 and 1960 is 32.6 per cent, which is much higher than even my upper-limit estimate for 1929-1963. The disagreement arises chiefly in the measurement of earnings by years of schooling. A list of the differences and their consequences follows:

1. As Table 2 reports, the shift in the distribution of workers by years of schooling was largely within the interval 8 to 12 years of schooling. A substantial part of the total improvement of the quality of labor consisted of the change in quality represented by the increase in schooling within that range. Denison's estimate is based on Houthakker's estimates of average annual income in 1959 of males between the ages of 25 and 64 years by years of schooling, which indicate an increase of 40 per cent in income with an increase in schooling from 8 to 12 years [3, p. 25]. If we look at Table 1, we can see that average hourly earnings among all males in the sample for the present study increased by a much smaller percentage over the closest corre-

sponding education interval. The increase in average hourly earnings between 5-8 years of schooling, the average of which is 7 years, and 12 years was only 18 per cent.

I use average hourly earnings rather than annual earnings because the index is designed to measure the quality of labor rather than the quantity: The effect of variation of annual hours on earnings should be eliminated. As we can see in Table 3, education is associated with hours of work. Among the restricted group of males between ages 25 and 64 the average annual hours of the group with 12 years of schooling exceeded that of the group with 5-8 years by 9 per cent. This table understates the effect of annual hours on earnings in Houthakker's estimates, because it is based on a sample which excluded those persons who reported no hours in the Census week of 1960 or

TABLE 3.—AVERAGE ANNUAL HOURS BY YEARS OF SCHOOLING AMONG EMPLOYED PERSONS IN NONAGRICULTURAL INDUSTRIES BASED ON HOURS IN A WEEK IN 1960 AND WEEKS WORKED IN 1959

Years of Schooling	All Men	Men Age Group 25-64	Women
0-4	1,824	1,862	1,471
5-8	1,924	2,001	1,493
9-11	1,924	2,107	1,446
12	2,102	2,186	1,601
13-15	2,063	2,194	1,512
16+	2,182	2,229	1,530

Source: *U. S. Census of Population and Housing: 1960*, 1/1,000 Sample. See note to Table 1.

no earnings in 1959, and Houthakker's estimates are for all males. The use of average hourly earnings as an index of quality leads to a smaller estimate of the increase in quality due to the increase in education than an index based on annual income.

Annual earnings may be more acceptable as a measure of the effective quantity of labor per man weighted by quality than as a measure of quality alone. If the purpose of the estimate is to quantify the sources of growth of total output rather than the sources of growth of output per man-hour, it may be desirable to use annual earnings to measure the effective quantity of labor per man weighted by quality. This approach assumes that the observed relation between weekly hours and years of schooling is stable and persistent. The relation would have to be explained by personal characteristics rather than by the irregularity of work arising from instability of demand or other job characteristics. In any case, growth in the quantity of labor due to greater education should not be counted twice. If there has been an increase in weekly hours from this source, then it is reflected in the estimated change in average weekly hours which is part of the measurement of the change in the quantity of labor.

2. The exclusion of persons reporting zero hours in the Census week of 1960 or zero earnings in 1959 reduces the effect of education. The purpose here again is to measure the association between the quality of labor per man-hour and education, rather than between the quantity of labor per man weighted by quality and education. Denison's estimate is based on average annual income of all males including those who were unemployed or out of the labor force. This estimate reflects the view that the incidence of unemployment among education groups is due to differences in personal characteristics rather than the level of demand.

3. The greatest increase in education has been among young persons. The present estimate is based on a measurement of the increase in education by age and sex. Education differentials in earnings increase with age. Denison's estimate of the increase in quality due to education did not control for age.

4. Denison used Houthakker's estimates of income by education groups which were for all workers including agricultural labor. The present estimates, as we have seen, are based on a sample which excludes such labor.

5. Houthakker did not exclude property income from income; he measured the association between education and total income. The present estimates are based on earnings.

The disparity between the two estimates is due also to the difference in the treatment of additional days per school year. The average number of school days per year increased both because of better attendance and the lengthening of the school year. Denison assumes that an additional school year represents no greater improvement in work skills than an equal number of additional days scattered throughout an entire schooling. No argument is presented in behalf of the assumption. Some of the additional time appears to be devoted to the study of the arts and humanities, which results in the cultivation of leisure skills rather than work skills. This is the principal reason for my decision to treat additional days per school year as equivalent to 70 per cent of the same number of days in additional years.

The choice of the school day as the unit of education influences Denison's result considerably. His estimate of the effect of additional school years on average earnings between 1930 and 1960 is 14.2 per cent. The use of the school day as the unit leads him to multiply the increase of 14.2 per cent by a factor measuring the proportional increase in the total number of school days, which yields the result of an improvement of 32.6 per cent.

The effect of varying the assumption on my estimate is much smaller because the estimate of the increment in earnings resulting from an additional year of schooling is much smaller than Denison's. Giving additional days per year full credit produces an estimate of improvement in quality due to education of 14.1 per cent; my assumption results in a figure of 11.9 per cent; not giving any credit for additional days reduces it to 6.8 percent. It is not unreasonable that the increase in the number of days per school year has contributed insignificantly to the development of work skills. Thus age may have some bearing on learning ability. The study of the relation between schooling and work skills still is in a primitive stage. The range of the esti-

mates corresponding to the extreme assumptions is considerable and calls for further study.

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\* The author is professor of economics at the New School for Social Research. The National Bureau of Economic Research sponsored the study of retail trade, of which the present paper is a product. The Board of Directors of the National Bureau have not reviewed this paper, which should be regarded therefore as solely an expression of the author's views. The study was part of the National Bureau's project on the service industries, which the Ford Foundation supported. I have benefited from numerous discussions with Victor Fuchs, the director of the project. I also wish to acknowledge the assistance of Lynda Psachie, Irving Leveson, Linda Nasif, Harriet Rubin, Judy Mitnick, and Avrohn Eisenstein, who worked with me at different times. Charlotte Boschan wrote the program for the analysis of the data provided by the 1/1000 sample of the 1960 Censuses of Population and Housing. Certain data used in this publication were derived by the author from punched cards furnished under a joint project sponsored by the U. S. Bureau of the Census and the Population Council and containing selected 1960 Census information of a 0.1 per cent sample of the population of the United States. Neither the Census Bureau nor the Population Council assumes any responsibility for the validity of any of the figures or interpretations of the figures published herein based on this material.

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### The Myth of Absolute Advantage: Comment

A recent communication by Professor Brandis, "The Myth of Absolute Advantage" [1], claims that Ricardo's concept of absolute advantage" is inconsistent with his own assumptions. Brandis argues that Ricardo supposes by arithmetic example that an "absolute advantage" country produces a pair of goods with the aid of two factors, capital and labor, more productively than does its trading partner. But Ricardo also states that, if capital and labor were mobile, then both factors would not only move to the "absolute advantage" country but would produce in the new environment with "absolute advantage" performance. Brandis points out that this implies that the productivity advantage cannot be ascribed to the quality of the two factors in the example but must be ascribed to the intercession of another factor. Brandis adds correctly that the only factor which could explain this productivity advantage and which conforms to Ricardo's framework is resource endowment or "land." But then Brandis concludes that this uncovers an inconsistency in Ricardo's reasoning since reference to land as a third factor is precluded because "in Ricardo's thought rent was not a price-determining factor" [1, p. 170].

This is an erroneous conclusion. Ricardo eliminates the natural resource, land—with its variations in productivity due to differences in soil fertility and

other qualities—as a price determinant only in the case of a closed economy with perfect factor mobility. It is only possible here for market price to be determined at the margin where no rent component enters price because it is only here that capital (and labor) can move freely from one employment to another in pursuit of profit (and labor income) maximization. But since Ricardo postulates immobility of capital between countries, he carefully qualifies his core model and introduces his special case of trade between countries with the following statement: “The same rule which regulates the relative value of commodities in one country does not regulate the relative value of the commodities exchanged between two or more countries” [3, p. 81].

Once this qualification is taken into account, the supposed inconsistency in Ricardo’s analysis vanishes—Brandis’ “mysterious” third factor turns out to be the obvious one, land. Furthermore, Ricardo operates with a long-run price determinant and numeraire (labor time)—imperfect as the latter is by his own admission—which is exogenous to the price system. On the basis of such a standard, it is of course by no means a myth that absolute advantage based on economic resource endowment can exist and can be demonstrated. So Ricardo may rest in peace in regard to the issue raised by Brandis.

A mystery, however, which still remains to be cleared up is why Ricardo bothered with absolute advantage in the first place when this is such an unimportant case. The explanation probably is that he wished to defend free commerce between countries as being advantageous to both sides in the least obvious case—the one in which one country is less productive in all tradeable consumer goods and hence appears to have nothing to offer the other country. But once he had committed himself to such an extreme-case argument, he realized that his core analysis based on free competition and free mobility of all movable factors and commodities would lead to a solution inimical to his defense of free commerce.

Thus, immediately after presenting his famous Portugal-England wine-corn example, he makes the acknowledgment, which misled Brandis:

It would undoubtedly be advantageous to the capitalists of England, and to the consumers in both countries, that under such circumstances the wine and the cloth should both be made in Portugal, and therefore that the capital and labour of England employed in making cloth should be removed to Portugal for that purpose [3, p. 83].

It is true that Ricardo does not go on to specify that this flight of capital and labor would be detrimental to England and its remaining population as a whole. But there can be little doubt that he must have realized this implication since, given diminishing returns on land, the magnitude of domestic capital endowment was perhaps the most important variable determining national material welfare for him and for the other classical economists. Thus, Ricardo painted himself into a corner. It was probably in order to save his “extreme case” argument for free international commerce that he was led to add to his foreign trade model the postulate of immobility of capital between countries.<sup>1</sup>

<sup>1</sup> It should be very clear at this point that the transfer of capital from a country meant

It is on this score that Ricardo deserves to be criticized, especially since this assumption may well have had an inhibitory influence on the development of international trade theory. Further, it clashed with Adam Smith's views, which after all represented conventional theory in Ricardo's times,<sup>2</sup> it contradicted his own assumption of international capital mobility when he was arguing against slowing down the introduction of machinery in the same work,<sup>3</sup> and it certainly was not then or now borne out by empirical evidence. One might even conclude with Parson Malthus, though this would not be fashionable in this age of formal analysis, that economics may have been better off had Ricardo been a little less cavalier and more realistic in his assumptions even at the cost of being a little less rigorous in his logic [2, pp. 4-6].

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### The Myth of Absolute Advantage: Comment

In a recent note in this *Review* [2], Professor Royall Brandis argued that the concept of "absolute advantage" is a myth, a logical impossibility that should be discarded. I shall argue that Brandis has overstated his case, and that in some contexts the concept remains valid and useful.

I agree with Brandis that absolute advantage cannot exist under the strict assumptions of the Heckscher-Ohlin, or factor proportions, theory of international trade. This theory requires the assumptions that production functions are linear, homogeneous, and identical in the two countries, that the produc-

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for Ricardo the actual removal from a country of "food, clothing, tools, raw materials, machinery" . . . "which (are) employed in production" [3, p. 53]. This raises some sticky problems of comparability between Ricardo's and our contemporary conceptualization and analysis—but these will not be discussed here.

<sup>2</sup>It was of moment to Smith's analytical preference for agriculture that the capital of manufacturers and merchants, which is not fixed in agriculture, is internationally footloose. Thus, Smith writes, "The capital, however, that is acquired to any country by commerce and manufactures, is all a very precarious and uncertain possession . . . A merchant . . . is not necessarily the citizen of any particular country . . . a very trifling disgust will make him remove his capital, and together with it all the industry which it supports, from one country to another" [4, p. 395], also see [4, pp. 345, 880].

<sup>3</sup>"The employment of machinery could never be safely discouraged in a state, for if a capital is not allowed to get the greatest net revenue that the use of machinery will afford here, it will be carried abroad . . ." [3, p. 271].

tion functions are such that at any given factor-price ratio commodity  $X$  requires a higher proportion of capital to labor than does commodity  $Y$ ,<sup>1</sup> that factors are perfectly mobile within (and immobile between) countries, and that perfect competition exists in both countries. Given these assumptions, it follows in the two-factor, two-commodity case that nothing remains on the *supply* side except the relative endowment of the two factors ( $C$  and  $L$ ) to provide a basis for differences in pre-trade price ratios in the two countries. It also follows that the country with a relative abundance of capital will have a comparative advantage in  $X$ .<sup>2</sup> This country (call it  $A$ ) produces both commodities with more capital, but less labor, than does  $B$  in the pre-trade situation. Therefore, we cannot say that either country has an absolute advantage unless we wish to make comparisons in terms of a single factor. This is Brandis' point, and thus far I agree with him. (I would add that I believe international economists are generally in agreement on this point, and that no one speaks of absolute advantage in the Hecksher-Ohlin context, except perhaps as a slip of the tongue.)

Brandis' conclusion that absolute advantage should be expunged from the economist's vocabulary seems to stem from his complete acceptance of the Hecksher-Ohlin theory, especially the assumption that production functions are identical. He notes that Ricardo, in his England-Portugal example, does not explain *why* Portuguese labor and capital are more productive in both industries, "... and the explanation of why he does not ... is because there is no reason" [2, p. 170]. In another place he says that those models which assume that the same quantities of inputs produce different quantities of output in the two locations "... contain the curious error of assuming that a production function knows where it is and acts differently in different locations" [2, p. 171].

Now, Brandis may be correct in his belief that production functions are everywhere identical, but we must recognize that in the present state of knowledge this is no more than a hypothesis, and that other hypotheses are at least possible. For their part, classical economists were unworried by the fact that their analysis relied upon unexplained differences in productivity in the two countries. As Caves has said, they thought the assumption "that  $X$  units of labor might produce different quantities of the same product in different countries was a 'realistic' assumption seldom felt to call for systematic defense or elaboration" [3, p. 10]. The Ricardian example clearly implies the following (different) production functions in the two countries:

*England*  
Cloth:  $C = 1/100 L$   
Wine:  $W = 1/120 L$

*Portugal*  
 $C = 1/90 L$   
 $W = 1/100 L$

This assumption is evidently unacceptable to Brandis, but he has no right to

<sup>1</sup> This assumption is not strictly necessary to prove that absolute advantage cannot exist. Its purpose is to make certain that each country has a comparative advantage in that commodity which requires relatively much of its abundant factor.

<sup>2</sup> A qualification is needed to prevent differences in demand patterns in the two countries from swamping the effect of differing relative factor endowments.



reject it a priori. Indeed, recent work by Minhas and others [1] [5] has cast doubt on the assumption of identical production functions. In models containing the assumption of different production functions, one example of which is the Ricardian model given above, absolute advantage still has a clear, definite meaning. If Brandis would have us renounce such models, and thus eliminate the possibility of absolute advantage, then he must offer *proof* that production functions are identical.

Brandis' faith in identical production functions leads him to argue that examples containing differential productivities should be corrected by redefining the units in which factors of production are measured in order to make the outputs come out right. In dealing with a "two-resource case" from a popular study guide, Brandis says that, if units of capital and labor mean the same thing in area A as in area B, then a given amount of capital and labor would produce the same output in the two areas. "The only other way out is to say that a 'unit of capital' in area B is not the same thing as a 'unit of capital' in area A and similarly for a 'unit of labor'" [2, p. 172]. This comment is reminiscent of Leontief's suggestion that his paradoxical result for U.S. trade could be made consistent with factor-proportions theory by multiplying the U.S. labor force by a number large enough to make the United States a "labor abundant" country vis-à-vis the rest of the world [4]—a suggestion that appeared to convert theory into tautology. If all differentials in factor productivity are removed by redefining units of the factors, the theory becomes empirically empty.

Another aspect of this issue is a basic one, involving the relationship between the definitions of "production function" and "factor of production." When we drop the convenient assumption of two homogeneous factors of production and confront the complexities of reality, it becomes difficult to list all the factors of production and to define them unambiguously. Those who wish to retain the assumption of identical production functions can resort to an ever finer classification of the factors to account for observed differences in output from given inputs, while those who assume that production functions are different can work with fewer factors and broader categories. For example, if production of a ton of oranges requires  $h$  labor and  $k$  capital in Florida, and  $3h$  labor and  $20k$  capital in Maine, one may argue either (a) that climate is one dimension of the production function, that Maine possesses little or none of the requisite climatic factor of production, and that it must therefore use larger amounts of capital and labor to make up for its climatic deficiency, or (b) that production functions are different in the two regions because of the different climates and that Florida has an absolute advantage in terms of the factors actually included in the production function. Similarly, because of special qualities of its soil, if Brazil can produce twice as much coffee as Argentina can with the same quantities of land, labor, and capital, one can either consider production functions to be different, or one can treat the various types of soil as different factors of production, in which case Brazil's greater output can be attributed to her greater input of the type of soil best suited to coffee-growing. As Robinson has said:

No matter how unlike the production environments of two countries happen to be, they can be considered as sharing a common production function if that function is given a sufficiently large number of dimensions. The concept of a "factor" must then, of course, bear a heavier burden; and it may become more difficult to compare factor supplies so as to speak meaningfully of "relative endowments" [7, p. 172-73].

In view of the difficulties in measuring factor inputs, it seems likely that, in any empirical studies that will be feasible in the foreseeable future, factors must be defined in such a way that the existence of absolute advantage will remain a definite possibility.

In his Section VI ("The Source of the Error"), Brandis shows that examples of absolute advantages turn out to be examples of comparative advantage when converted into opportunity cost ratios in each country. He regards this fact as further proof of the nonexistence of absolute advantage, perhaps because he thinks that absolute and comparative advantage are "mutually exclusive cases" [2, p. 174]. This is indeed a curious error. Ever since Ricardo, economists have recognized that all trade is based on comparative advantage, and that a case of comparative advantage *may* also be a case of absolute advantage. If we *assume* Ricardo's (different) production functions in England and Portugal, Portugal has an absolute advantage in both commodities but *also* a comparative advantage in one of them (wine) because the opportunity cost ratios are different:  $C = 5/6 W$  in England,  $C = 9/10 W$  in Portugal. Brandis' implication, that such conversion of absolute advantage examples into relative price differences in the two countries is evidence that absolute advantage is impossible, is simply wrong.

The concept of absolute advantage has great heuristic value in showing the advantage of specialization in such homely examples as the engineer who is a better draftsman than his clerk but who maximizes income by specializing in engineering. One can hardly improve on Ricardo's own example:

Two men can both make shoes and hats, and one is superior to the other in both employments, but in making hats he can only exceed his competitor by one-fifth or 20 per cent, and in making shoes he can excell him by one-third or 33 per cent;—will it not be for the interest of both that the superior man should employ himself exclusively in making shoes, and the inferior man in making hats? [6, p. 83n]

Since Brandis proposes to eliminate absolute advantage from the economist's vocabulary, I wonder how he would deal with this case. Of course, interpersonal differences in productivity may result from differences in education, and one might treat a man as a package of capital and labor, with the proportions differing from one man to another. However, we may produce examples in which productivity differs even when education and other such variables appear to be equal, at least as far as measurement can take us. Are we then to say that Mr. A has more innate ability than Mr. B, and treat this ephemeral quality as a factor of production of which A uses more than B, thus negating absolute advantage? If so, we are back to tautology. If not, then absolute advantage still exists; and if it can exist for two individuals, it is at least con-

ceivable that one region's population may be composed of people like Mr. A, and another's of people like Mr. B, so that interregional absolute advantage must also be admitted.

The other great heuristic value of absolute advantage is that it helps us to show that trade is beneficial to both countries *even if* one country can produce both goods more efficiently (i.e., with less of every resource) than another. Indeed, it should be noted that the only reason we need to use the term *comparative* advantage is the existence of absolute advantage. The adjective, comparative, was introduced to show that, even if A has an absolute advantage (or disadvantage) in both goods, it can still gain from trade if its advantage in one good is larger than in the other—i.e., if relative prices differ in the two regions prior to trade. In the pure Heckscher-Ohlin case, where absolute advantage cannot exist, there is no reason for any adjective. A country simply has an advantage in one good, a disadvantage in the other.

I conclude that it is futile to search for absolute truth about absolute advantage, and premature to speak of discarding it as a myth. Whether or not the concept is useful and meaningful depends on the context.

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### The Myth of Absolute Advantage: Reply

Professor Anspach argues that Ricardo really had a third productive resource, Land, in mind when he presented his exposition of absolute advantage. If he is correct in this interpretation (which can only be derived by inference since Ricardo certainly did not say so), then Ricardo's example of absolute advantage becomes nothing more than a case in which the resource endowments (including Land) of England and Portugal are such that England has a

comparative advantage in the production of cloth, Portugal in the production of wine. If this be so, the notion of absolute advantage should never have entered the literature of economics in the first place. We are then left with the puzzle of why a piece of political propaganda on Ricardo's part became a permanent fixture in the literature of international trade theory.

I think Anspach may be closer to the true explanation with his second suggestion that Ricardo believed that in labor time he had found a measure of value which was exogenous to the price system. For it does appear that Ricardo, unlike many who came after him, realized that no absolute standard of value could be found *within* the economic system. What he did not realize was that a standard exogenous to the system was irrelevant for economic analysis. Nor did he see that an absolute standard was not even necessary since economic theory is concerned only with *relations*.

Professor Ingram's criticisms involve both theoretical and empirical considerations and the two can best be discussed separately. Little need be said about the empirical questions since my original note was not concerned with them. The difficulty (if not impossibility) of finding the precise real-world counterparts of the constructs of a theoretical model is a commonplace in economics (and, indeed, in any other scientific discipline). No one supposes the "national income" of macrotheory to be the same thing as the "national income" of the natural accounts. But one cannot sustain an attack on the logic of the theory by pointing this out or require the theorist to furnish empirical proof that they are identical—as Ingram would have me do with production functions. The relation between theoretical model and real world is an epistemological question and was not the question raised in my note which was a more modest question of logic.

The stance on theory which Ingram takes reflects a different problem—the refusal of some economists to accept the fact that only relative economic concepts have meaning in any scientifically acceptable sense. The price of a product or of a productive resource is a relative price whether measured in money terms or real terms. For this reason, to describe anything as being "cheaper" is to describe something else as being more expensive. And it is elementary logic that, thus, everything cannot be "cheaper."<sup>2</sup> In like fashion, the use of the term "more efficient" can only mean, in economics, lower cost of production and, in turn, this has meaning only if related implicitly or explicitly to something else which is "less efficient" or higher cost. I would hazard the guess that Ricardo did not see the nature of his problem because he believed his labor theory of value provided an absolute standard of measurement of value.

The lawyer-typist, engineer-draftsman, shoemaker-hatmaker examples of absolute advantage always contain a word like "better" (Ingram) or "superior" (Ricardo) which implies some absolute standard of measurement which cannot be *economically* relevant as a basis for trade. The Ricardian shoemaker-hatmaker example cited by Ingram tells us only that the "superior" individual will have a higher income than the "inferior" individual whether he makes

<sup>2</sup> J. S. Mill [1, p. 540-41] saw this point clearly a century ago in his analysis of value, but that is not to say that he was consistent in applying it throughout his system of thought.

shoes or hats. But the "superior" individual cannot make *both* shoes and hats more cheaply (in any meaningful economic sense) than the less productive individual. Only the most naive labor theory of value would hold otherwise. However, I would not deny that the labor theory of value has hung on in expositions of international trade theory long after it has been discarded elsewhere in the discipline. Perhaps this is the price we pay for our fascination with the notion of absolute advantage. I would deny the heuristic value of any model, homely or otherwise, which violates the most elementary rules of logic and the most basic assumptions of economics. Our inheritance from the past of a felt need to have an absolute standard of measurement is something we should try to free ourselves from rather than defend. And when books have passed through several editions I doubt that the logical errors which remain deserve to be excused as "slips of the tongue."

Some writers treat absolute advantage and comparative advantage as mutually exclusive cases. Some treat absolute advantage as a subdivision of the general case of comparative advantage. In the latter treatment, as far as I know, the residue (that part which is *not* in the absolute advantage category) is unnamed or called "comparative advantage" also. In fact, these categories have no bearing on the basis for trade. Rather, the two cases are the one in which we can determine which nation has the higher per worker or per capita income (the "absolute advantage" case) and the case in which the higher per worker or per capita income nation cannot be determined (the "residue").<sup>2</sup> But this has nothing to do with the *basis for trade* which purports to be the subject of discussion in all the treatments of absolute advantage.

I would close by saying that my attack on the concept of absolute advantage does not spring from "... complete acceptance of the Hecksher-Ohlin theory ..." (Ingram). It springs rather from my belief that illogic and irrelevance have no place in economic theory.

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<sup>2</sup> For example, in Ricardo's classic case of absolute advantage, we see immediately that per worker real income is higher in Portugal than England. If we change the figures slightly so as to have a case of comparative advantage (or the "residue" of the general case of comparative advantage if that terminology is preferred) we might have the following:

	<i>England</i>	<i>Portugal</i>
Cloth (equal quantity)	90 man-years	100 man-years
Wine (equal quantity)	120 man-years	80 man-years

With only this information, we cannot determine which nation has the higher per worker real income, but we can determine the basis for trade.

Again, we might present a model in which the nation with the higher per worker real income is readily apparent, but in which there is *no* basis for trade. Such a model would be the following:

### On the Theory of Optimum Externality: Comment

While acknowledging the ingenuity of Dolbear's diagrammatic construction [1], a "general" model of a two-person economy that produces in effect one good and one "bad" in fixed proportions appears to yield no conclusion that could not be drawn more simply from a partial analysis—at least, one wherein we permit ourselves the convenience of using money as a yardstick and wherein we use a Figure having marginal curves instead of indifference and transformation curves. The treatment presented here enables us to elaborate in a more familiar way the arguments leading to his first conclusion: (1) that the optimal output produced will depend upon the extent of legal responsibility. In addition, it simplifies the critical examina-

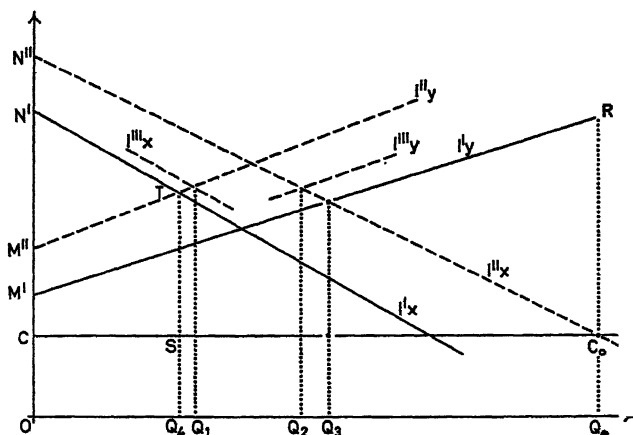


FIGURE 1

tion of three other conclusions (in my order); (2) that it is not in general possible to impose a constant per unit tax that both achieves an optimal output and compensates exactly for damages; (3) that some of the standard tax proposals will not in general establish an optimal output; and (4) that it is not simple "to regulate externality" with tax schemes.

Along the horizontal axis of Figure 1 we measure units of heat and smoke, these being produced in fixed proportions.<sup>1</sup> Along the vertical axis we measure for *X* (assumed provisionally to be affected only by heat) the marginal value of successive units of heat and, for *Y* (assumed provisionally to be affected only by smoke), the marginal value of compensation required for

	<i>England</i>	<i>Portugal</i>
Cloth (equal quantity)	90 man-years	60 man-years
Wine (equal quantity)	120 man-years	80 man-years

Portugal clearly has the higher per worker real income. It is equally clear that there is no basis for trade between the two nations.

<sup>1</sup> I adopt Dolbear's assumption of fixed proportions which is not, however, essential in the treatment proposed here. Whatever the amounts of smoke associated with successive units of heat production, they entail compensatory payments that have to be subtracted from the marginal valuation of heat.

successive units of smoke.  $OC$  measures the constant per unit cost of heat. Any point along  $X$ 's marginal indifference curve<sup>3</sup>  $N'-I''_x$  is consistent with  $X$ 's welfare prior to any heat being available at all. Thus,  $X$  would pay a maximum of  $ON'$  for a first unit of heat, the vertical height of the  $N'-I''_x$  curve indicating the maximum payments  $X$  would make for successive units of heat which, if paid, make him no better off than he is without heat. If, however,  $X$  were permitted to buy heat freely at cost  $OC$ , he would make a consumer's surplus of  $CN'$  on the first unit, an addition to his welfare that would raise his marginal indifference curve—assuming a positive welfare effect—and would, therefore, raise the maximum amounts he would pay for all successive units. A consumer's surplus on his second unit would further raise his welfare and therefore his marginal indifference curve, and so on for all successive units until he was in equilibrium buying  $OQ_0$  units of heat, at which point his final marginal indifference curve  $N''-I''_x$  would cut the  $CC_0$  line.<sup>4</sup> In the absence of an anti-smoke law, and prior to any agreement between  $X$  and  $Y$ ,  $OQ_0$  is the output of heat, and smoke, produced.

At the welfare level remaining to  $Y$  when  $Q_0$  units of smoke are produced the maximum he will pay to rid himself of the first unit is given by  $C_0R$ . If he paid the maximum for each unit of smoke successively withdrawn his welfare would remain unchanged and the marginal indifference curve traced would be that in the Figure shown by  $M'-I''_y$ .<sup>4</sup> If, however, an anti-smoke law were in effect, his welfare would be higher, and the minimum sum that would induce him to bear with a first unit of smoke would be measured by  $CM''$ . If he were paid the minimum acceptable to him for all successive units of smoke the sums would trace the marginal indifference curve  $M''-I''_y$ .

# I

We now consider Dolbear's conclusion (1), that the optimal output of smoke production depends on legal responsibility, by reference to this construct. Obviously if an anti-smoke law exists there is initially no smoke, and if there is no such law the initial smoke output is  $OQ_0$ . If we ignore all costs of decision-taking—which, in practice, might prevent any movement from either of these extremes—and allow negotiation, the optimal output of smoke (and heat) will vary with the law. If in the first place an anti-smoke law prevailed which, however, could be waived in particular instances by voluntary agreement between the affected parties,  $Y$  could be exactly compensated by  $X$  with a payment of  $CM''$  for the first unit of smoke suffered by  $Y$ , successive units borne by  $Y$  being compensated according to the

<sup>3</sup> The marginal indifference curve is the curve of the first derivative of the corresponding indifference curve.

<sup>4</sup> Thus, the marginal indifference curve  $N''-I''_x$  is the first derivative of the highest indifference curve reached when ( $OQ_0$ ) units of heat are bought at price  $OC$ . Any point along  $N''-I''_x$  reveals the maximum payment  $X$  is willing to make for the corresponding unit when his welfare remains unchanged at the level associated with the  $N''-I''_x$  curve.

<sup>4</sup> This upward-sloping curve has the normal shape, in that paying for a "bad" to be removed is akin to buying a good, and is downward-sloping when moving from right to left. On the other hand, the  $M''-I''_y$  curve is to be regarded as moving from left to right, in the usual way, since  $Y$ 's acceptance of successive units of smoke, a "bad," is akin to surrender of successive units of a good for which he requires increasing amounts of compensation.

height of the  $M''-I''_y$  curve measured from the  $CC_0$  line. The optimal smoke output would be at  $Q_1$  at which point some marginal indifference curve for  $X$ ,  $I'''_x$  ( $I''_x < I'''_x < I''_x$ ) cuts the  $I''_y$  curve. For, as a result of  $X$ 's making compensatory payments to  $Y$  that are less than  $X$ 's initially maximum payments (as indicated by his  $I''_x$  curve),  $X$ 's welfare continues to rise until the optimal output is reached and, along with it, his marginal indifference curve.

If, on the other hand, the law were permissive with respect to smoke, we begin at output  $OQ_0$  with  $Y$  taking the initiative in offering compensation to  $X$  for foregoing heat. If  $Y$  paid exact compensation to  $X$ , payments per unit would follow the difference between  $CC_0$  and the  $N''-I''_x$  line moving leftward. Since these payments are smaller than the maximum that  $Y$  could offer to rid himself of successive units of smoke (while maintaining his welfare at the  $OQ_0$  smoke level),  $Y$ 's welfare increases as compared with his situation when  $OQ_0$  units of smoke are produced, and his corresponding marginal indifference curve rises from  $I''_y$  to  $I'''_y$  ( $I''_y < I'''_y < I''_y$ ) at which level it cuts the  $N''-I''_x$  curve. The optimal amount of smoke is now at  $Q_2$ , which amount is necessarily larger than the amount  $Q_1$  reached from the anti-smoke law.

The conclusion that—assuming always positive welfare effects—the optimal amount of “social damage” will always be smaller if the law is initially anti-“social damage” (regardless of decision costs) is not altered, indeed it is strengthened, if either side pays more than the required minimum compensation. Beginning from an anti-smoke law, for example, if  $X$  paid to  $Y$  more than is indicated by  $Y$ 's  $M''-I''_y$  curve,  $X$ 's resulting  $I'''_x$  curve would be lower than that indicated in the Figure while the relevant marginal indifference curve for  $Y$  would be above  $M''-I''_y$ . The resulting optimal output would therefore be still less than  $Q_1$ . Similar reasoning beginning with a permissive smoke law would reveal an optimal output greater than  $Q_2$ . For “normal,” or positive, welfare effects it therefore follows that if more than exact compensation is paid the difference in optimal outputs arising from a difference in the law is greater.

## II

Let us now take the analysis a stage further by considering the opportunities for tax-induced optima. In the absence of an anti-smoke law the welfares of  $X$  and  $Y$  before agreement are those associated with  $M'-I'_y$  and  $N''-I''_x$ . As distinct from the realized output under these conditions,  $Q_0$ , the optimal smoke output consistent with these particular levels of welfare is that given by  $Q_3$  at the intersection of the two curves in question. Regardless of what the government does with the tax proceeds, it is just not possible to reach  $Q_3$  by imposing any kind of excise tax on heat alone—unless the excise tax paid by  $X$  is exactly offset by a direct subsidy to him—simply because the effect of such a tax is to reduce  $X$ 's welfare and place him on a marginal indifference curve below that of  $N''-I''_x$ . However, in qualification of conclusion (2),  $Q_3$  could be realized if, instead, the government offered  $X$  an excise subsidy for reducing his consumption of heat from  $Q_0$  to  $Q_3$  by reference to  $X$ 's  $N''-I''_x$  curve while at the same time levying an



excise tax on  $Y$  for the removal of successive units of smoke from  $Q_0$  to  $Q_3$  by reference to  $Y$ 's  $M' - I'_y$  curve.

Similarly, if, instead, an anti-smoke law prevailed in the first instance, the relevant welfares would be those associated with  $I'_x$  and  $I''_y$ , for which levels of welfare the optimal output is  $OQ_4$ . This optimal output could be realized on removing the smoke prohibition only by imposing an excise tax on  $X$  according to his  $N' - I'_x$  curve while offering an excise subsidy to  $Y$  according to his  $M'' - I''_y$  curve up to output  $Q_4$ . In this case also, since the welfare levels of  $X$  and  $Y$  remain unchanged, the government will be left with some net revenue. In contrast, if instead  $X$  and  $Y$  negotiated their way to some optimal output (which could not be  $Q_4$  or  $Q_3$ ) the government would gain nothing but the welfare levels of one or both parties would be raised.

What is not generally possible, however, is to impose only a *constant* excise tax on heat and reach exactly either  $Q_4$  or  $Q_3$  (where initial welfare gains or losses are exactly compensated) since such a tax must alter  $X$ 's initial welfare as indicated either by  $I'_x$  or  $I''_x$ . Even if one is constrained to constant excise taxes, however, this distributional effect need not worry one since the government can always influence the distribution of welfare through transfer payments while promoting optimal outputs by excise taxes.

Conclusion (3) also needs qualifying, if not correcting. If we do decide to introduce an excise tax on each successive unit of heat produced by  $X$  then, prior to any heat production, the initial marginal indifference curves are  $N' - I'_x$  and  $M'' - I''_y$ , with optimal output  $OQ_4$  corresponding to these respective levels of welfare. The excise tax suggested by the diagram is equal to  $TS$ . But the levying of constant excise tax on heat of exactly  $TS$  may not result in an optimal output—assuming the government does not use any of the tax proceeds to compensate  $Y$ .<sup>5</sup> This is because the constant excise tax,  $TS$ , being initially below the maxima that  $X$  would pay for successive units of heat, raises  $X$ 's welfare and also, therefore, his marginal indifference curve above  $N' - I'_x$ . For  $Y$ , on the other hand, the introduction of successive units of smoke serves only to reduce his marginal indifference curve below  $M'' - I''_y$ . Thus, the tax  $TS$  may prove too high or too low to coincide with the intersection of the resultant marginal indifference curves for  $X$  and  $Y$ , and if so it would not be an optimal tax. However, if the tax  $TS$  turns out to be above the intersection of the resultant marginal indifference curves it is clearly too high and must be revised downward. Conversely, if it turns out to be below this intersection, it is too low and must be revised upward. Allowing for continuity, there is always some constant excise tax which is consistent with the resulting intersection of the marginal indifference curves for  $X$  and  $Y$  and, therefore, is consistent with an optimal output.

### III

These results are not surprising. Levels of welfare for  $X$  and  $Y$  corresponding to an initial nonoptimal output—either to that of a smoke-permitting law or that of an anti-smoke law—cannot be maintained if, in establishing

<sup>5</sup> If the government exactly compensates  $Y$ , his original  $M'' - I''_y$  curve is maintained, the required tax exceeds  $TS$ , and the optimal output to be reached is still greater than  $OQ_4$ . If however, the government more than fully compensates  $Y$ , the required tax is greater still, but the optimal output could be anywhere in the neighbourhood of  $OQ_4$ .

optimal outputs, excise taxes or subsidies are such as to alter these welfare levels. If it is important that such welfare levels be maintained it may be achieved as indicated, either by a system of excise taxes and subsidies that follow the path of each of the relevant marginal indifference curves, or else by constant excise taxes plus lump sum transfers. In the absence of such special measures, however, it must be accepted that government tax intervention, in particular a constant excise tax or subsidy, will have distributive effects on welfare. If an exact optimal output is established—and in principle it may always be established by some constant excise tax—it will not in general be consistent with the initial levels of welfare. However, any desired distribution of welfare can be established in the first instance by lump sum transfers and to any such welfare distribution there corresponds an optimal output, one that could be realized, if necessary, by either of the tax devices indicated above.

And this brings us to the last of Dolbear's conclusions considered here (4), that it is not simple to "regulate externality" with a tax system. This is a practical matter. An exact rate of excise tax, though conceptually determinate for some optimal output, would obviously be difficult to calculate. But such a difficulty is not peculiar to external effects. It is general to the calculation of any excise tax aimed to produce an exact optimal output, an exact amount of tax revenue, or an exact reduction in output. For in all such cases the distribution of welfare is to some extent affected and consequently the relevant marginal indifference curves are shifted. Thus, even if statistical estimates of the demand and supply schedules were perfect, and were deemed to be absolutely reliable over the future, we could not calculate an exact result without having, also, perfectly accurate information about welfare-induced shifts of the marginal indifference curves.

Does this matter? Hardly. Provided the welfare effects involved are small, the deviation from some exactly defined output is likely to be small. In a science of human behavior, where a ten per cent error of prediction over a several-year period is more an occasion for rejoicing than dismay, such difficulties cannot be taken seriously. If by excise taxes and/or subsidies the government can bring the economy as a whole closer to overall optimality—while correcting, if necessary, unwanted distributional effects through direct transfers—it need not feel inhibited by the practically insurmountable difficulties of exact calculations.<sup>6</sup>

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<sup>6</sup> As an addendum to the above, it may be remarked that the introduction of many buyers of heat and many smoke victims, which requires that individual marginal indifference curves be added, the aggregate marginal indifference curves will, in general, be different for each different initial distribution of welfare. This implication, plus the possibility that some individuals will both buy heat and suffer smoke, poses no special conceptual problems. Optimal positions are multiplied, but, as in the two-person case, they are all exactly determinate. The actual calculation of exact optimal positions, however, will always be impracticable.

### On the Theory of Optimum Externality: Comment

One of the major points in a recent article by F. T. Dolbear, Jr., which appeared in this *Review* [1], was the demonstration that "it is not in general possible to impose a per-unit tax [on someone generating external diseconomies] which will simultaneously compensate (exactly) for damages and achieve a Pareto optimum" [1, p. 102]. If this is so, it obviously has serious consequences for public authorities who desire to eliminate the inefficiencies associated with marginal external diseconomies of various types. This note will show, however, that Dolbear's conclusion is really less general than it appears. There will always be some "per-unit tax" which will exactly compensate for damages and attain a Pareto optimum, if it is possible to attain a Pareto optimum at all.

A brief summarization of Dolbear's reasoning will help to illustrate this point. He considers a two-person model in which one person in producing heat for himself also generates smoke, which adversely affects the other person. He further makes the assumption, which turns out to be critical, that the damaged individual suffers in increasing marginal disutility from smoke (or experiences decreasing marginal utility from fresh air). Presumably, as this individual approaches asphyxiation, each increment of smoke imposes larger and larger amounts of disutility on him, so that he is willing to pay more and more to avoid or remove additional smoke. This implies that the cost, in terms of subjective utility loss, which smoke imposes on the damaged person is not constant for each unit of heat-smoke, but rather increases as more and more units of smoke are consumed.

When this assumption about the shapes of indifference curves is translated into a statement about subjective costs, Dolbear's conclusion does not appear surprising. It is no wonder that a tax imposed at a constant rate per unit of heat-smoke will not exactly compensate an individual who experiences costs which increase per unit of smoke.

What kind of tax would exactly and optimally compensate is also clear from this analysis. It would be a per-unit tax, because its base would be the number of physical units of smoke (or heat), but it would be an *increasing*, rather than a constant per-unit tax. Such a tax would imply an after-tax budget line which is not straight, but rather is concave to the origin. In Dolbear's Figure 4, this line would be tangent to the damaged party's "starting point" indifference curve. This tax would allow the damaged individual to be exactly compensated and at the same time would lead to a Pareto optimum.<sup>1</sup>

This conclusion is not without some practical significance. It suggests, for instance, that in situations in which Dolbear's assumption of increasing marginal disutility of dirty air is appropriate, decision-makers who desire to compensate exactly should consider, not constant per-unit taxes, but ones which increase per unit output of the externality-generating good.<sup>2</sup>

<sup>1</sup> Dolbear's suggestion of a lump-sum *subsidy* plus a per-unit tax on the source of pollution amounts to an increasing per-unit tax when averaged over all units of output. See [1, p. 99].

<sup>2</sup> This analysis assumes, as does Dolbear's, that there is a one-to-one relationship between output of the externality-generating good and that of the externality.

More generally, and perhaps more importantly, it suggests that qualitative characteristics of an optimal tax should be tailored to those of the cost being imposed. It might well be the case that consumers experience *decreasing* marginal disutility from pollution. For instance, once pollution makes a lake unfit for swimming and drinking purposes, additional increments of pollution, which serve only to make it more odiferous, might produce smaller and smaller reduction in consumers' utilities. In such a case, optimality could be achieved by a per-unit tax which *decreased* per unit of output.<sup>3</sup>

Another and probably quite common situation would be one in which consumers experience *constant* costs of pollution. For instance, by the operation of some kind of mechanical device, consumers might well be able to remove pollution at a constant marginal cost of pollution removed.<sup>4</sup> It would then be irrelevant whether they get decreasing marginal utility from clean air or not, so long as the global optimality conditions were not violated (i.e., so long as the total cost of removing the pollutant did not exceed the total benefits from cleaner air to the damaged individuals). In his analysis, Dolbear ignored the possibility, which may be fairly general, that the damaged individual could be returned to his starting-point indifference curve by methods other than compensation for damages suffered. If this possibility is considered, it appears that a constant per-unit tax may exactly and optimally compensate damaged individuals in a great number of cases. A per-unit tax, even a constant one, will lead to a Pareto optimum more often than Dolbear suggests.

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### On the Theory of Optimum Externality: Reply

It was not my intention to suggest that taxes (or subsidies) cannot play a major role in mitigating the effects of externalities. Rather, I wished to indicate, using conventional assumptions of price theory, that some *qualifications* to the usual classroom externality prescription are necessary. Such qualifications notwithstanding, I have considerable sympathy for Pigovian tax-subsidy policies.

Pauly's comment is directed toward my conclusion that "it is not in general possible to impose a per-unit tax which will simultaneously compensate (exactly) for damages and achieve a Pareto optimum." He promises to show the desired result *can* be achieved with a "per-unit tax." However, it turns out

<sup>3</sup> Alternatively, optimality could be attained by a per-unit tax and a lump-sum tax levied on the source of pollution.

<sup>4</sup> In such a case, knowledge of the costs of reducing damage from pollution may also be much easier to obtain than in the cases Dolbear [1, pp. 99-101] considers.

that he has in mind an "increasing per-unit tax"; the average as well as the total tax depends on quantity consumed.<sup>1</sup> In general of course, the necessary marginal conditions can be satisfied with a constant per-unit tax which equates marginal social and private cost, and the distribution of income can be changed through lump sum transfers. Pauly accomplishes the same end—through variable inframarginal tax rates. His method is similar to variable rates often advanced for optimal pricing of public utilities.

Pauly also shows that increasing, constant, or decreasing per-unit taxes would be appropriate where the marginal disutility of smoke was increasing, constant, or decreasing (respectively). I agree. However, as I pointed out in section V, there are difficulties in applying these tax rules to situations involving many polluters. In these cases, Pauly's suggestions—to move along the damaged party's indifference curve—will not work. To be sure, it will still be possible in theory to achieve a Pareto optimum with exact compensation for damages. But the exact compensation tax rates which should be presented to the individual polluters cannot be simply derived from the curvature of the starting point indifference curve. Damage (and thus exact compensation) depends on aggregate pollution; consequently, information on the preferences of the polluters is required to derive taxes on individuals which will yield appropriate aggregate payments. Moreover, Pauly's increasing per-unit tax will not, in the general case, be sufficient. If individual polluters are spread over the range of output, a constant marginal rate will be necessary (to satisfy the marginal conditions) and lump sum transfers will be required.

Turning to Mishan's comments, I find his restatement of the problem interesting though I must confess I do not find marginal evaluation curves easy to work with. They are particularly troublesome in analyzing income effects, an important ingredient in the problem at hand. This difficulty is (at first blush) avoided where, in internalizing the externality, Mishan holds constant the welfare levels of *both* parties. However, as Mishan realizes, this is an illusion because income is generated for a third party (government) whose preferences are not represented in the model. This of course is what makes it a "partial analysis." Mishan's construct is especially ill suited for handling cases which involve constant per-unit taxes since not only will the income of the government be affected but also the level of welfare of the two parties. Although Mishan does consider this latter effect on optimal output, the analysis is awkward. It is an unfortunate feature of the model that changes in income cannot be treated systematically but require *ad hoc* shifting of curves.

I have several specific comments. First, Mishan's extensions of my results are easily exhibited in my "triangular Edgeworth box." For example, optimum solution  $Q_3$ , holding welfare levels in the absence of an anti-smoke law constant, can be located in my Figure 3 (p. 95) where the slopes of indifference curves  $I_1^x$  and  $I_1^y$  are equal. The income (bread) which the government receives is represented by the vertical distance between the two curves. A similar correspondence can be found between solution  $Q_4$  and curves  $I_2^x$  and  $I_2^y$ .

<sup>1</sup> From an informal poll of my colleagues, I feel reinforced that most economists think a per-unit tax involves a *constant* rate per unit. However, as the discussion below will indicate, I feel the problem is more than semantics.

Second, Mishan's use of taxes and subsidies as *incentives* to internalize externality is not clear. In section II, he employs variable taxes or subsidies to transform the opportunity locus of  $X$  and  $Y$  onto the appropriate marginal evaluation curve. However, this will not, contrary to Mishan's expectation, induce either to select the intersection of the curves over other (equally desirable) points along the appropriate marginal evaluation curve. Since neither is being made better off, neither has an incentive to maximize. The intersection could be induced through lump sum transfers combined with a per-unit tax (or subsidy) on  $X$ .

Finally, Mishan considers whether it will be simple to regulate externality with a tax system. I agree that it is a practical matter. He suggests the problem is likely to be small because the welfare effects of the internalizing technique will be small. However, in some real world cases that come to mind (e.g., Pauly's example of water pollution), compensation at marginal damage rates leads to considerable deviation from exact compensation.

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## The Economics of Moral Hazard: Comment

When uncertainty is present in economic activity, insurance is commonly found. Indeed, Kenneth Arrow [1] has identified a kind of market failure with the absence of markets to provide insurance against some uncertain events. Arrow stated that "the welfare case for insurance of all sorts is overwhelming. It follows that the government should undertake insurance where the market, for whatever reason, has failed to emerge" [1, pp. 945, 961]. This paper will show, however, that even if all individuals are risk-aversers, insurance against some types of uncertain events may be nonoptimal. Hence, the fact that certain kinds of insurance have failed to emerge in the private market may be no indication of nonoptimality, and compulsory government insurance against some uncertain events may lead to inefficiency. It will also be shown that the problem of "moral hazard" in insurance has, in fact, little to do with morality, but can be analyzed with orthodox economic tools.

The particular type of insurance for which the argument will be presented is that of insurance against medical care expenses, for it was in a discussion of medical expense insurance that Arrow framed the propositions cited above. However, the analysis is applicable as well to other types of insurance, such as automobile collision insurance.

### I. The Welfare Implications of Insurance

It is assumed that all individuals are expected utility maximizers and are risk-aversers, and that the incidence of illness is a random event. This excludes preventive medicine from consideration, and it also ignores the effect that medical insurance might have on the purchase of preventive care. Bernoulli's theorem, as cited by Arrow [1, pp. 959-61], states that such individ-

uals will prefer insurance with a premium  $m$  which indemnifies against all costs of medical care to facing without insurance a probability distribution of such expenditures with mean  $m$ .

There is a social gain obtained by purchase of this insurance (as long as the insurer suffers no social loss) since pooling of risks reduces the total risk, and therefore the risk per insured, because of the Law of Large Numbers. Of course, the existence of transactions costs means that the policy is not really offered at the actuarially fair premium  $m$ . However, since the individual preferred actuarially fair insurance to self-insurance, he will prefer some insurance with an actuarially unfair premium to self-insurance, so long as the premium is not too "unfair." His preference in this regard will depend on the intensity of his risk aversion and the strength of the Law of Large Numbers in reducing risk.

As indicated above, Arrow concluded from this analysis that the absence of commercial insurance against some uncertain medical-care expenses provides a case for government intervention to provide such insurance. Dennis Lees and R. D. Rice [6] answered that this insurance was not offered because of selling and transactions costs. Arrow [2] replied, in effect, that such costs were dead-weight losses anyway, and indeed would be eliminated by compulsory social insurance. It seems clear, however, that there is another and better way to explain why some insurances are not offered commercially. It is to show that some, perhaps many, medical care expenses are not "insurable" in the standard sense.

In order for the welfare proposition given above to be valid, the costs of medical care must be random variables. But if such expenses are not completely random, the proposition no longer holds. The quantity of medical care an individual will demand depends on his income and tastes, how ill he is, and the price charged for it. The effect of an insurance which indemnifies against all medical care expenses is to reduce the price charged to the individual at the point of service from the market price to zero. Even if the incidence of illness is a random event, whether the presence of insurance will alter the randomness of medical *expenses* depends on the elasticity of demand for medical care. Only if this demand is perfectly inelastic with respect to price in the range from the market price to zero is an expense "insurable" in the strict sense envisioned by Arrow's welfare proposition.

Suppose, for example, that an individual faces the probability  $p_1 = \frac{1}{2}$  that he will not be sick at all during a given time period (event  $I_1$ ) and so will demand no medical care, probability  $p_2 = \frac{1}{4}$  that he will contract sickness  $I_2$ , and probability  $p_3 = \frac{1}{4}$  that he will contract "more serious" sickness  $I_3$ . The position of his demand curve for medical care depends on which illness, if any, he contracts. In Figure 1, it is assumed that his demand curves  $D_2$  and  $D_3$  are perfectly inelastic, and that his demand curve for the "no illness" case is identical with the  $y$ -axis. Without insurance, the individual faces the probability  $p_1$  that he will incur no medical expenses, the probability  $p_2$  that he will need 50 units of medical care (which is assumed to be priced at marginal cost), and the probability  $p_3$  that he will need 200 units of medical care at a cost of 200  $MC$ . The mean of this probability distribution (or the expected values of the

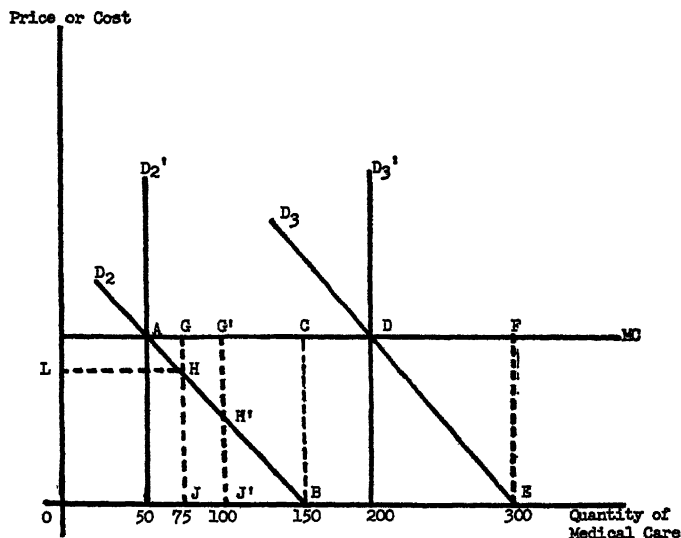


FIGURE 1

individual's medical care expenses) equals  $(\frac{1}{2} \times 0 + \frac{1}{4} \times 50 MC + \frac{1}{4} \times 200 MC)$  or  $62.5 MC$ . Hence, an actuarially fair insurance which indemnifies the individual against all costs of medical care could be offered at a premium  $P$  of  $62.5 MC$ . Arrow's welfare proposition indicates that the individual would prefer paying a premium of  $62.5 MC$  to risking the probability distribution with the mean  $m = 62.5 MC$ .

Suppose, however, that the individual's demand curves are not all perfectly inelastic, but are as  $D_2'$  and  $D_3'$ . Then the individual has to choose between facing, without insurance, the probability distribution  $(\frac{1}{2} \times 0 + \frac{1}{4} \times 50 MC + \frac{1}{4} \times 200 MC)$  with a mean  $m$  of  $62.5 MC$ , and paying a premium of  $P = (\frac{1}{2} \times 0 + \frac{1}{4} \times 150 MC + \frac{1}{4} \times 300 MC) = 112.5 MC$  in order to obtain insurance. In such a case, he may well prefer the risk to the insurance.

The presence of elasticity in the demand curves implies therefore that the individual will alter his desired expenditures for medical care because of the fact of insurance. The individual who has insurance which covers all costs demands medical care as though it had a *zero* price, but when he purchases insurance, he must take account of the *positive* cost of that care, as "translated" to him through the actuarially necessary premium. Hence, he may well not wish to purchase such insurance at the premium his behavior as a purchaser of insurance and as a demander of medical care under insurance makes necessary.<sup>1</sup>

<sup>1</sup>This is exactly the same sort of "inconsistency" that Buchanan has noted in connection with the British National Health Service. Individuals demand medical care as though it were free but in voting decisions consider the positive cost of such care. Hence, they vote, through their representatives in the political process, to provide facilities for less medical care than they demand in the market. See [4].



The presence of a "prisoners' dilemma" motivation makes this inconsistency inevitable.<sup>2</sup> Each individual may well recognize that "excess" use of medical care makes the premium he must pay rise. No individual will be motivated to restrain his own use, however, since the incremental benefit to him for excess use is great, while the additional cost of his use is largely spread over other insurance holders, and so he bears only a tiny fraction of the cost of his use. It would be better for all insurance beneficiaries to restrain their use, but such a result is not forthcoming because the strategy of "restrain use" is dominated by that of "use excess care."

If the demand for medical care is of greater than zero elasticity, the existence of this "inconsistency" implies that inefficiency may well be created if individuals are forced, by taxation, to "purchase" insurance which indemnifies against some kinds of medical care expense. For an efficient solution, at least some price-rationing at the point of service may be necessary.

Suppose there are no significant income effects on the individual's demand for medical care resulting from his payment of a lump-sum premium for insurance. In Figure 1, the inefficiency loss due to behavior under insurance, if that insurance were compulsory, would then be roughly measured by triangles *ABC* and *DEF*. These areas represent the excess that individuals do pay over what they would be willing to pay for the quantity of medical care demanded under insurance. Against this loss must be offset the utility gain from having these uncertain expenses insured, but the net change in utility from a compulsory purchase of this "insurance" could well be negative.

Moreover, if individual demands for medical care differ, it is possible that the loss due to "excess" use under insurance may exceed the welfare gain from insurance for one individual but fall short of it for another individual. It follows that it may not be optimal policy to provide compulsory insurance against particular events for all individuals. Some events may be "insurable" for some persons but not for others. It also follows that some events, though uncertain, may not be insurable for anyone. If persons differ (a) in the strength of their risk aversion or (b) in the extent to which insurances of various types alter the quantity of medical care they demand, an optimal state will be one in which various types of policies are purchased by various groups of people. There may be some persons who will purchase no insurance against some uncertain events.

Insurance is more likely to be provided against those events (a) for which the quantity demanded at a zero price does not greatly exceed that demanded at a positive price, (b) for which the extent of randomness is greater, so that risk-spreading reduces the risk significantly, and (c) against which individuals have a greater risk-aversion. There is uncertainty attached to "catastrophic" illness, but it appears that the elasticity of demand for treatment against such illness is not very great (in the sense that there is one and only one appropriate treatment). Furthermore, the "randomness" attached to such illnesses is relatively great, in the sense that they are unpredictable for any individual, and people's aversion to such risk is relatively great. Hence, one would expect to

<sup>2</sup> For a discussion of the prisoners' dilemma problem, see [7].

find, and does find, insurance offered against such events. Similar statement might be made with respect to ordinary hospitalization insurance.

There is also some uncertainty attached to visits to a physician's office, but the extent of randomness and risk-aversion is probably relatively low for most persons. The increase in use in response to a zero price would be relatively great. One would not expect to find, and does not in general find, "insurance" against such events. Similar analysis applies to insurance against the cost of dental care, eyeglasses, or drugs.

## II. *Moral Hazard*

It has been recognized in the insurance literature that medical insurance, by lowering the marginal cost of care to the individual, may increase usage; this characteristic has been termed "moral hazard." Moral hazard is defined as "the intangible loss-producing propensities of the individual assured" [4, p. 463] or as that which "comprehends all of the nonphysical hazards of risk" [5, p. 42]. Insurance writers have tended very strongly to look upon this phenomenon (of demanding more at a zero price than at a positive one) as a moral or ethical problem, using emotive words such as "malingering" and "hypochondria," lumping it together with outright fraud in the collection of benefits, and providing value-tinged definitions as "moral hazard reflects the hazard that arises from the failure of individuals who are or have been affected by insurance to uphold the accepted moral qualities" [5, p. 327], or "moral hazard is every deviation from correct human behavior that may pose a problem for an insurer" [3, p. 22]. It is surprising that very little economic analysis seems to have been applied here.<sup>3</sup>

The above analysis shows, however, that the response of seeking more medical care with insurance than in its absence is a result not of moral perfidy, but of rational economic behavior. Since the cost of the individual's excess usage is spread over all other purchasers of that insurance, the individual is not prompted to restrain his usage of care.

## III. *Deductibles and Coinsurance*

The only type of insurance so far considered has been an insurance which provides full coverage of the cost of medical care. However, various devices are written into insurance, in part to reduce the moral hazard, of which the most important are deductibles and coinsurance.<sup>4</sup> The individual may well

<sup>3</sup> In his original article, Arrow mentions moral hazard as a "practical limitation" on the use of insurance which does not "alter the case for creation of a much wider class of insurance policies than now exist." [1, p. 961]. However, Arrow appears to consider moral hazard as an imperfection, a defect in physician control, rather than as a simple response to price reduction. He does not consider the direct relationship which exists between the existence of moral hazard and the validity of the welfare proposition. More importantly, in the controversy that followed [2] [6], moral hazard seems to have been completely overlooked as an explanation of why certain types of expenses are not insured commercially.

<sup>4</sup> A deductible is the exclusion of a certain amount of expense from coverage; coinsurance requires the individual to pay some fraction of each dollar of cost.

prefer no insurance to full coverage of all expenses, but may at the same time prefer an insurance with these devices to no insurance.<sup>5</sup>

### A. *Deductibles*

Suppose the insurance contains a deductible. The individual will compare the position he would attain if he covered the deductible and received additional care free with the position he would attain if he paid the market price for all the medical care he consumed but did not cover the deductible. If income effects are absent in Figure 1, the individual will cover a deductible and consume 150 units of medical care when event  $I_2$  occurs as long as the "excess" amount he pays as a deductible (e.g., area  $AGH$  for a deductible of 75  $MC$ ) is less than the consumer's surplus he gets from the "free" units of care this coverage allows him to consume (e.g., area  $HJB$ ). If the deductible exceeds 100  $MC$  (at which point area  $AG'H'$  equals area  $H'J'B$ ), the individual will not cover the deductible and will purchase 50 units. Hence, the deductible either (a) has no effect on an individual's usage or (b) induces him to consume that amount of care he would have purchased if he had no insurance. If there are income effects on individual demands, because the deductible makes the individual poorer his usage will be restrained somewhat even if he covers the deductible.

### B. *Coinsurance*

Coinsurance is a scheme in which the individual is, in effect, charged a positive price for medical care, but a price less than the market price. The higher the fraction paid by the individual, the more his usage will be curtailed. In Figure 1, if he had to pay  $OL$  of each unit's cost, he would reduce his usage if event  $I_2$  occurred from 150 units to 75 units. The smaller the price elasticity of demand for medical care, the less will be the effect of coinsurance on usage.

It is possible for the restraining effect of coinsurance to reduce moral hazard enough to make insurance attractive to an individual who would have preferred no insurance to full-coverage insurance. Indeed, there is an optimal extent of coinsurance for each individual. The optimal extent of coinsurance is the coverage of that percentage of the cost of each unit of medical care at which the utility gain to the individual from having an additional small fraction of the cost of each unit of care covered by insurance equals the utility loss to him upon having to pay for the "excess" units of care whose consumption the additional coverage encourages. If the marginal gain from the coverage of additional fractions of cost always exceeds the marginal inefficiency loss, he will purchase full coverage insurance; if the marginal loss exceeds the marginal gain for all extents of coinsurance, the individual will purchase no insurance. If individual demands differ, the optimal extent of coinsurance will differ for different individuals.

<sup>5</sup> Arrow [1, pp. 969-73] gives some other arguments to explain why the individual will prefer insurance with deductibles or coinsurance to insurance without such devices.

## IV. Conclusion

It is possible to conclude that even if all individuals are risk-aversers, some uncertain medical care expenses will not and should not be insured in an optimal situation. No single insurance policy is "best" or "most efficient" for a whole population of diverse tastes. Which expenses are insurable is not an objective fact, but depends on the tastes and behavior of the persons involved.

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## The Economics of Moral Hazard: Further Comment

Mr. Pauly's paper [3] has enriched our understanding of the phenomenon of so called "moral hazard" and has convincingly shown that the optimality of complete insurance is no longer valid when the method of insurance influences the demand for the services provided by the insurance policy. This point is worth making strongly. In the theory of optimal allocation of resources under risk bearing it can be shown that competitive insurance markets will yield optimal allocation when the events insured are not controllable by individual behavior. If the amount of insurance payment is in any way dependent on a decision of the insured as well as on a state of nature, then the effect is very much the same as that of any excise tax and optimality will not be achieved either by the competitive system or by an attempt by the government to simulate a perfectly competitive system. For some earlier, less detailed, discussions of this point see [1, pp. 55-56], [2, pp. 961-62].

In this note, I would like to stress a point which Mr. Pauly overlooks in his exclusive emphasis on market incentives. Mr. Pauly has a very interesting sentence: "The above analysis shows, however, that the response of seeking more medical care with insurance than in its absence is a result not of moral per-

fidy, but of rational economic behavior." We may agree certainly that the seeking of more medical care with insurance is a rational action on the part of the individuals if no further constraints are imposed. It does not follow that no constraints ought to be imposed or indeed that in certain contexts individuals should not impose constraints on themselves. Mr. Pauly's wording suggests that "rational economic behavior" and "moral perfidy" are mutually exclusive categories. No doubt Judas Iscariot turned a tidy profit from one of his transactions, but the usual judgment of his behavior is not necessarily wrong.

The underlying point is that, if individuals are free to spend as they will with the assurance that the insurance company will pay, the resulting resource allocation will certainly not be socially optimal. This makes perfectly reasonable the idea that an insurance company can improve the allocation of resources to all concerned by a policy which rations the amount of medical services it will support under the insurance policy. This rationing may in fact occur in several different ways: (1) there might be a detailed examination by the insurance company of individual cost items allowing those that are regarded "normal" and disallowing others, where normality means roughly what would have been bought in the absence of insurance; (2) they may rely on the professional ethics of physicians not to prescribe frivolously expensive cost of treatment, at least where the gain is primarily in comfort and luxury rather than in health improvement proper; (3) they may even, and this is not as absurd as Mr. Pauly seems to think, rely on the willingness of the individual to behave in accordance with some commonly accepted norms.

The last point is perhaps not so important in the specific medical context, but the author had clearly broader implications in mind and so do I. Because of the moral hazard, complete reliance on economic incentives does not lead to an optimal allocation of resources in general. In most societies alternative relationships are built up which to some extent serve to permit cooperation and risk sharing. The principal-agent relation is very pervasive in all economies and especially in modern ones; by definition the agent has been selected for his specialized knowledge and therefore the principal can never hope completely to check the agent's performance. You cannot therefore easily take out insurance against the failure of the agent to perform well. One of the characteristics of a successful economic system is that the relations of trust and confidence between principal and agent are sufficiently strong so that the agent will not cheat even though it may be "rational economic behavior" to do so. The lack of such confidence has certainly been adduced by many writers as one cause of economic backwardness.

The lesson of Mr. Pauly's paper is that the price system is intrinsically limited in scope by our inability to make factual distinctions needed for optimal pricing under uncertainty. Nonmarket controls, whether internalized as moral principles or externally imposed, are to some extent essential for efficiency.

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### The International Flow of Human Capital: Comment

In a paper published in the *American Economic Review* of May, 1966 [2], Herbert Grubel and Anthony Scott argue that the emigration of highly skilled individuals should be evaluated in terms of its effect on the income of the individuals remaining in the country. Using this criterion the authors reason that "... emigration should be welcome ..." whenever the following two conditions are met: "... first that the emigrant improves his own income and, second, that the migrant's departure does not reduce the income of those remaining behind" [2, p. 270]. The first condition is assumed to be met when the individual emigrates of his own free will. The second condition is deemed to be met in the case of a "... market economy where persons are paid their marginal product ..." and hence where "... the emigrant removes both his contribution to national output and the income that gives him a claim to this share so that other incomes remain unchanged" [2, p. 270]. The authors acknowledge that emigration may cause a redistribution of income by changing the marginal products of the remaining people, but they argue that "... since the brain drain involves rather small numbers of people, these effects are likely to be small enough to be safely considered negligible" [2, p. 270]. Grubel and Scott then conclude that a reduction in the welfare of the remaining population could only arise out of short-run adjustment costs or failures of the free market to allocate resources efficiently (i.e., the case of external economies or the case of market failure remedied through activities of the government). In the case of externalities, Grubel and Scott distinguish between external economies which are associated with the personal characteristics of the emigrant and external economies which are associated with his profession. In regard to external economies associated with the emigrant's profession, the authors state that:

... if a typical doctor's work contains a large measure of social benefits for which he does not get compensated, these benefits are lost to society only for the length of time required to train another person to take his place as a doctor. It therefore follows that in many of the well-known instances of genuine external effects in consumption or production, emigration imposes only short-run frictional costs to society which disappear in the long run. [2, p. 271]

Finally, having found that only minor or temporary losses in income could result from emigration of the highly skilled, Grubel and Scott conclude by

stating: "A good case can therefore be made for a continuation of present policies and the free movement of human capital throughout the world" [2, p. 274].

# I

The results of the Grubel and Scott analysis if applied to an underdeveloped country, for example, tell us that the remaining population of the underdeveloped nation is not adversely affected if highly skilled individuals leave. This seems to be a rather amazing conclusion in view of the fact that the shortage of skilled personnel is generally considered to be a major factor in preventing the economic development of such nations. The fact is, however, that the conclusion of Grubel and Scott is arrived at only because of an error in their analysis. The error is found in the statement "in a market economy where persons are paid their marginal product" which, literally interpreted, implies that all employed persons are paid their marginal product. This is not true, of course, because it is only the marginal worker who receives the full value of his marginal product with all workers being paid only what the marginal worker is worth. Hence if we look at a market economy at two points in time, first with  $n$  skilled workers and a given quantity of other factors of production (including unskilled workers), and second with  $n - 1$  skilled workers and the same quantity of the other factors, it is true that there will be no reduction in the income available for the remaining factors of production (i.e., income available to the remaining skilled workers and the constant quantity of other factors). On the other hand, if we start at the same initial equilibrium position and then compare it to a new equilibrium position with the economy now having  $n - 2$  or fewer skilled workers, we will find that the income available for the remaining population has been reduced, since while the first skilled emigrant will reduce national product by an amount equal to his income, the second and each succeeding emigrant will reduce national product by an amount which is greater than the income which they had been receiving in the initial situation. Consequently, the Grubel-Scott analysis holds only for the marginal-skilled worker and emigration of significant numbers of highly skilled individuals does tend to reduce the income of the remaining population.

The crux of the matter can be illustrated by using Figure 1, in which is plotted the marginal product for highly skilled workers (plotted as rectangles as opposed to a smooth curve in order to see more clearly the effect of the withdrawal of individual workers) in a perfectly competitive economy. It is assumed that initially there are five skilled workers in the economy but that, in the absence of emigration restrictions, three of the five skilled workers will leave the country. The initial total product of the economy is the sum of the areas under rectangles  $A$  through  $E$ , and  $W_1$  is the initial wage paid to skilled workers. The question then is what effect does the emigration of the three skilled workers have on the income of the remaining population?

According to their argument Grubel and Scott would apparently analyze this situation as follows: Emigration of the fifth skilled worker reduces national product by rectangle  $E$  which is the income of the skilled worker, and

hence there is no reduction in the income available for the remaining population (i.e., the remaining four skilled workers plus the rest of the country's population). Once the fifth skilled worker has left, the wage paid to skilled workers will increase to  $W_2$  and emigration of the fourth skilled worker then reduces national product by rectangle  $D$ , which is now the income of the fourth skilled worker and hence there is no reduction in the income available

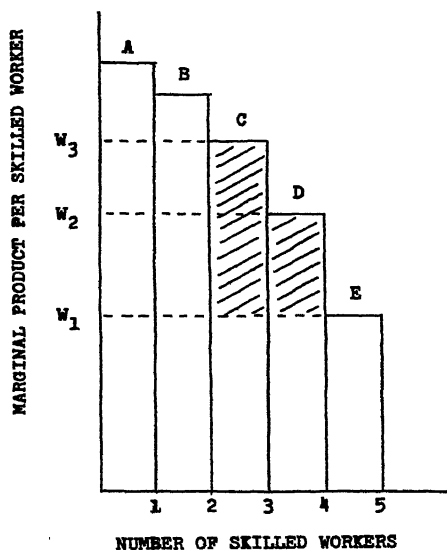


FIGURE 1

for the remaining population (which is now the remaining three skilled workers plus the rest of the country's population). Once the fourth skilled worker has departed, the wage paid to skilled workers will increase to  $W_2$ , and thus emigration of the third skilled worker reduces national product by rectangle  $C$ , which is now the income of the third skilled worker and hence there is no reduction of the income available for the remaining population (which turns out to be finally the remaining two skilled workers plus the rest of the country's population).

Actually, the Grubel-Scott argument is nothing more than a series of separate static comparisons of an economy with and without the skilled worker at the margin. In terms of the above example, the Grubel-Scott approach, as implied in their article, is not to compare an economy with five skilled workers to an economy with two skilled workers but rather to compare an economy with five skilled workers to an economy with four skilled workers and then to compare an economy with four skilled workers to an economy with three skilled workers, and so on.

This approach is erroneous because in attempting to deal with the emigration of two or more skilled workers the argument classifies some skilled work-



ers as both emigrants and part of the remaining population. More precisely, in terms of the above example, the Grubel-Scott approach would classify the fourth skilled worker as "remaining behind" until emigration of the fifth skilled worker has increased the income of the fourth worker at the expense of the other factors of production. Since the other factors of production are owned by individuals who are a part of what will actually be the remaining population while the fourth skilled worker is not, it is at this stage that the income of the remaining population is reduced. Of course, keeping the fourth skilled worker in the "remaining population" category until after this redistribution of income and only then reclassifying him as an emigrant gives Grubel and Scott their conclusion that emigration of the fifth and fourth skilled workers does not reduce the income available to the remaining population. The Grubel-Scott analysis in turn would keep the third skilled worker in the remaining population category until after emigration of the fifth and fourth workers has increased the income of the third, again at the expense of the remaining population. Only then is the third skilled worker reclassified as an emigrant.

Clearly, if one is to analyze the effect of the emigration of highly skilled workers on the income available to the remaining population one must specify at the outset which skilled workers, in the absence of emigration restrictions, will emigrate (and hence cannot be considered part of the remaining population) and which skilled workers will remain in the country.

One must then compare the income of the population remaining after all skilled emigrants have departed to the income the same population had been receiving prior to the departure of the skilled workers. In terms of our example, one should compare the income of the population which will be left if the three skilled workers are allowed to emigrate to the income available to the same people if the three skilled workers had been forced to remain. This is certainly the appropriate comparison since if the country allows free emigration it will end up with only two skilled workers whereas if it prevents emigration of the highly skilled it will be able to retain its original supply of five skilled workers. In our example, the remaining population (or what will be the remaining population if free emigration is allowed) consists of the given non-highly-skilled population plus the two skilled workers who will not emigrate. The income available to the remaining population then consists of the wages paid to the first and second skilled workers plus the income of the other factors of production. As can be seen from Figure 1, prior to emigration of the three highly skilled workers the income of what will be the remaining population consists of rectangles *A* and *B* plus the area above  $W_1$  in rectangles *C* and *D*. After emigration of the three skilled workers, the income available to the remaining population consists only of the area in rectangles *A* and *B*. The income of the remaining population has thus been reduced by the shaded areas in rectangles *C* and *D*. Clearly the income of the remaining population always tends to be reduced when a free market economy loses two or more highly skilled workers. Consequently, on the basis of the authors' second criterion (i.e., that there be no reduction in the income of the remaining population)

their recommendation "for a continuation of present policies and the free movement of human capital throughout the world" is unjustifiable.

It should be noted that the above argument is a general one, applicable to unskilled as well as skilled labor. While the emigration of either skilled or unskilled workers will tend to reduce the income of the remaining population, there is an important difference between the two classes of labor in terms of the distributional effects of emigration. Emigration of unskilled labor, while it will reduce the income of the remaining population, will also have the favorable effect of bringing about a more equal distribution of income by raising the wages of the remaining unskilled workers at the expense of other factors of production, including skilled workers. Emigration of skilled workers, on the other hand, will not only reduce the income available to the remaining population, but it will also tend to redistribute income from unskilled labor to the remaining skilled workers. Hence emigration of the highly skilled reduces the income of the "poor" and increases inequality of income. Because of this adverse effect on income distribution and because Grubel and Scott's own findings show that some countries are losing a significant number of highly skilled workers,<sup>1</sup> one must have serious reservations about the authors' conclusion that the redistribution effects can be ignored.<sup>2</sup>

## II

Another weakness in the Grubel and Scott argument is their use of absolute reductions in present income as the criterion for determining whether or not emigration has an adverse effect on the remaining population. The selection of this criterion forces one into a comparative static analysis of emigration and prevents one from analyzing dynamic effects. In considering two alternative policies (i.e., allowing the emigration of highly skilled workers and preventing such emigration) one must ask what is the opportunity cost of choosing a given policy? In the case of emigration of highly skilled workers the opportunity cost of allowing emigration is the income which would have become available to the remaining population if the highly skilled workers had not left the country. The use of opportunity cost leads to the conclusion that there can be no objection to emigration whenever the following two conditions are met: (1) the emigrant improves his own income and (2) the migrant's departure does not force the remaining population to relinquish either part of their present income or future increases in income. Even though we have already shown that present income of the remaining population will be reduced through emigration of the highly skilled, the adoption of this second condition leads to different conclusions than those reached by Grubel and Scott in other parts of their analysis.

First, it should be noted that a reduction in present income will tend to

<sup>1</sup> For example, the authors have found that Greece and Ireland exhibit "... what must be considered a substantial annual outflow of scientists and engineers to the United States, given the size of the educational efforts of these countries." [1, p. 373]

<sup>2</sup> Burton Weisbrod [5, p. 278] and Brinley Thomas [4, p. 493] have also questioned minimizing the distributional effects.

reduce future income by a larger amount than the absolute reduction in present income, since a reduction in present income also reduces saving and hence investment, which in turn reduces the ability of the economy to generate increases in income. Second, since the highly skilled individual who emigrates will have had a higher-than-average income, he will in all probability have had a higher-than-average amount of saving. His loss will then tend to reduce the per capita saving of the country and hence per capita investment. This in turn means that future per capita income of the remaining population will be less than it would have been if the highly skilled emigrant had not left.

Next, in regard to external economies which might be associated with the profession of the emigrant, it is true that the country of emigration can restore income reductions which result from the loss of external economies previously provided by, say, a doctor who has emigrated, by training another doctor to take his place. This point is, however, that *ceteris paribus* (including the educational expenditure to train an additional doctor), the remaining population would have been better off if the emigrant doctor had not left. If the doctor had remained, the given educational expenditure would have eventually increased the number of doctors and hence increased the amount of external economies provided by doctors. Consequently, there is an opportunity cost for the remaining population in the form of relinquished future income in allowing the emigration of individuals who provide external economies as a part of their work.<sup>8</sup>

Finally, it is true, as the Grubel-Scott analysis implies, that the emigration of college students (or the failure of students studying abroad to return) does not reduce the income of the remaining population, since the students have never been employed and hence have never contributed to national product. Nevertheless, while the remaining population does not experience a reduction in present income through student emigration, it is forced to forgo additional income since if the students had remained or returned and had become employed (it is assumed that we are dealing with more than one student) they would have increased national product by an amount in excess of the income they would have received. (If  $n$  college graduates who have equal ability enter the labor force, the  $n$ th graduate hired will have a marginal product equal to his wage while the other graduates will receive the same wage but will have marginal products higher than the wage received.) The excess addition to national product will accrue to other factors.

The above arguments have established that there is a significant opportunity cost in terms of both present and future income forgone for the remaining population of a country in allowing highly skilled individuals to emigrate. The actual decision as to whether or not a given country should restrict the emigration of all or a segment of its highly skilled population is basically a value judgment, however, since the decision involves improving the welfare of the general population at the expense of interference with the freedom of the indi-

<sup>8</sup> Thomas argues that since there are likely to be large discrepancies between marginal net social product and income in underdeveloped countries, these countries stand to gain (lose) large marginal external economies if their supply of skilled workers is increased (decreased) [4, pp. 493-94].

vidual to better himself by moving to another country in order to obtain a higher income.

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### The International Flow of Human Capital: Reply

If a person is paid his true marginal social product, his emigration leaves unchanged the incomes of those remaining in the country from which he leaves, except for the redistributive effects of government taxation and spending. Mr. Aitken's comment has failed to prove that this proposition is invalid. All Aitken has shown is that a large number of marginal changes over a relevant time period is equivalent to a nonmarginal change. This a rather well known proposition whose introduction does not show our analysis to be "in error," but extends it. Whether such an extension is a useful exercise and whether it is sufficient to establish that "there is significant opportunity cost in terms of both present and future income for the remaining population of a country in allowing highly skilled individuals to emigrate" as Aitken claims, depends on four factors.

First, can the skilled-person migrations of recent years be described as marginal? Since our and Aitken's analyses are comparative statics, it is necessary to consider periodic flow data, such as annual statistics, and not the cumulated amount of former migration. The basic data on which such judgments must be based have been made available by the U.S. Immigration and Naturalization Service [7]. Even if one takes these data as valid, there remain the difficulties of estimating the stock or current output of highly skilled people in individual countries, for which very few meaningful data are available, and then deciding at what magnitude of emigration a marginal change becomes nonmarginal, that is at .1, 1.0, 10.0, or 25.0 per cent of current output. Aitken has made no contribution to the solution of these difficulties. In our judgment emigration of highly skilled persons in recent years for most countries has been marginal.

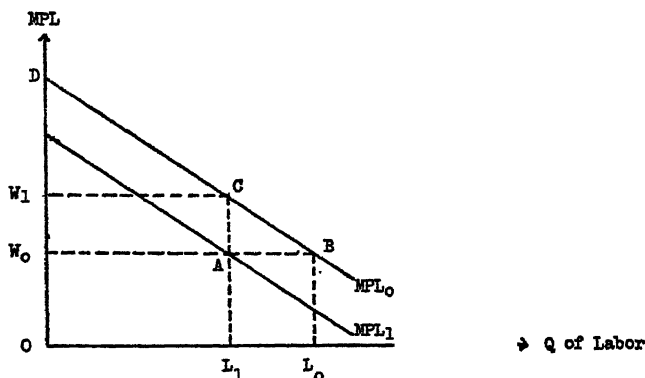


FIGURE 1

We arrive at this judgment in part because we have found the official U.S. immigration statistics to be highly misleading.<sup>1</sup> Immigration authorities are unable to ascertain the true level of schooling of persons who upon entering as immigrants indicate their professions as "engineers," "biologists," "economists," etc. Furthermore, the data fail to indicate where the schooling was obtained and how many of the immigrants return later. In a recent study these biases of the official statistics were shown to be substantial. Whereas the U.S. gain from Sweden over a given period was alleged to be 106, after proper adjustment for true schooling levels and return migration, Sweden's loss came to only 26 [2].

Second, the correct analysis of the effects of the nonmarginal emigration of highly skilled persons is more complicated than Aitken realizes. Consider the normal schedule of the marginal productivity of labor in Figure 1. The emigration of  $L_1L_0$  unskilled workers in the long run leads to a rise in wages from  $OW_0$  to  $OW_1$ , but the total income gained by the remaining labor,  $W_0ACW_1$ , is smaller than that lost by the owners of capital,  $W_0BCW_1$ . The deadweight loss  $ABC$  is, of course, the effect "discovered" by Aitken.

However, let us now consider what happens if  $L_1L_0$  skilled workers leave. From the economist's point of view the essential difference between skilled and unskilled workers is that the former have accumulated a certain amount of human capital. Recent analyses of the concept of human capital [1] [6] have stressed the long-run substitutability of human and physical capital in production functions and in the formation of capital. Therefore, the emigration of highly skilled persons reduces a country's total stock of social capital just as does the export or destruction of physical equipment. If the validity of this basic proposition is granted, it follows that the emigration of  $L_0L_1$  skilled workers shifts down the  $MPL$  schedule of unskilled labor because of the reduction in the stock of social capital. Any shift downward reduces the size of the deadweight loss. We have shown elsewhere [4] that the loss is completely eliminated if the value of the emigrants' human capital is equal to the country's per

<sup>1</sup> A detailed analysis of their shortcomings has been presented in [3].

capita endowment of human and physical capital, making the normal assumptions about constant returns to scale and absence of external effects.<sup>2</sup> On the other hand, the welfare loss can be greater than the one associated with the emigration of unskilled workers if the value of the human capital taken along substantially exceeds the per capita endowment, so that the shifted *MPL* curve intersects the line  $L_1C$  far below point *A* so as to produce a dead-weight loss triangle larger than *ABC* appearing in the marginal productivity of capital schedule.<sup>3</sup> It should also be noted that the proper incorporation of human capital into the analysis affects the conclusions about income distribution reached by Aitken in rather obvious ways. Furthermore, we wish to point to the fact that the analysis abstracts from short-run losses incurred while human and physical capital are reallocated. We have analyzed these in [4].

Third, we consider the logical validity of Aitken's argument that future income of the remaining population is reduced because the highly skilled emigrant would have had above average savings and raised society's per capita endowment with capital, labor productivity, and total income. This argument neglects entirely the fact that the owner of capital retains claim to its marginal productivity. In the absence of externalities and in equilibrium the marginal utility of borrowed savings is just equal to the last dollar spent on interest, which in turn is just equal to the marginal utility the borrower could have obtained by spending that dollar on other goods and services. Thus, according to economic theory the public remaining behind should be indifferent as to whether the emigrant accumulated his savings in one country or the other. Naturally, for nonmarginal changes this marginal analysis has to be modified in ways rather obvious from the preceding discussion.

Fourth, we turn to the validity of the estimate of the value of externalities associated with the profession of an emigrant. Our point has been in the past [5] that society loses the positive externalities of a medical doctor's work only for as long as it takes to train a replacement. This argument assumes the existence of a market mechanism, supplemented by rational government action to adjust for the externalities through the provision of subsidies in the training of doctors, which causes society to have a determinate stock of physicians that tends to optimal, given society's alternative uses of resources and tastes. For this reason, the loss of one doctor creates incentives to replace him and return to the optimum stock. Aitken's argument implies that the loss of one doctor reduces society's stock for all future times and therefore leads to a loss of the externalities he would have provided for an infinite period in the future. Such a model may describe conditions of the medical profession in the United States at present but we are dubious about its general validity. When govern-

<sup>2</sup> Given a linear homogeneous production function, equi-proportionate reductions in the factors of production leave relative prices of these factors unchanged. Therefore, the new marginal productivity of labor schedule must go through point *A* if labor and social capital are reduced in equal proportions.

<sup>3</sup> In [4] we have shown that in 1957 the value of total human plus physical capital per person in the United States was approximately \$14,400. The human capital value of a person with two years of college education that same year was \$14,300. Further research is required to obtain similar estimates for other industrial and the less developed countries, where capital endowment per person is lower but where the cost of instruction and earnings-foregone components of human capital formation are lower also than in the United States.

ments decide to build medical schools they are subjected to pressures from engineers, natural scientists, and others to provide something that from society's point of view resembles an optimum mix and level of practitioners in the various professions.

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#### Returns to Scale and the Spacing of Isoquants: Comment

Levenson and Solon [2, pp. 501-5] show that as input quantities are increased isoquants become closer together, are evenly spaced, or become farther apart, as *marginal* returns to scale are increasing, constant, or decreasing. Spacing and marginal returns are examined along a vector with the two inputs varied by equal percentages, and the production function is assumed to display first increasing, then constant, and finally decreasing, marginal returns to scale.

As early as 1911 Edgeworth [1, p. 363] perceived that marginal returns to scale should logically be measured along the expansion path the firm actually utilizes (isocline), and not along a vector. It is the purpose of this comment to examine spacing and marginal returns along both vector and isocline expansion paths. It is shown that increasing marginal returns continue on an isocline after the point of constant marginal returns has been reached along a vector.

Let  $Q$ ,  $X$ , and  $Y$ , be quantities of output and two inputs,  $k$  be the scale

coefficient, and  $a$  and  $b$  be arbitrary positive constants. Then:

$$\begin{aligned}(1) \quad & Q = f(X, Y) \\(2) \quad & k = aX + bY\end{aligned}$$

Isoquants become closer, are evenly spaced, or become farther apart, and marginal returns to scale are increasing, constant, or decreasing, as:

$$\frac{d^2k}{dQ^2} \begin{cases} \leq 0 \\ \geq 0 \end{cases}$$

From (1) and (2):

$$(3) \quad \frac{dk}{dQ} = \frac{a(dX/dY) + b}{f_X(dX/dY) + f_Y}$$

and:

$$\begin{aligned}\frac{d^2k}{dQ^2} = & \frac{[f_X(dX/dY) + f_Y]ad/dQ(dX/dY)}{[f_X(dX/dY) + f_Y]^2} - \\ & \frac{[a(dX/dY) + b][(dX/dY)f_{XX}(dX/dQ) + (dX/dY)f_{XY}(dY/dQ) + f_Xd/dQ(dX/dY)]}{[f_X(dX/dY) + f_Y]^2} \\ & - \frac{[a(dX/dY) + b][f_{XY}(dX/dQ) + f_{YY}(dY/dQ)]}{[f_X(dX/dY) + f_Y]^2}\end{aligned}$$

Since  $d/dQ(dX/dY) = (d^2X/dY^2)(dY/dQ)$ ,  $(dX/dQ) = (dX/dY)(dY/dQ)$ , and  $(dQ/dY) = f_X(dX/dY) + f_Y$ , then:

$$(4) \quad \frac{d^2k}{dQ^2} = \frac{[af_Y + bf_X](d^2X/dY^2) - [a(dX/dY) + b] \cdot [f_{XX}(dX/dY)^2 + 2f_{XY}(dX/dY) + f_{YY}]}{[f_X(dX/dY) + f_Y]^2}$$

along either vector or isocline expansion path. In the vector case:

$$(5) \quad \frac{dX}{dY} = X/Y, \quad \frac{d^2X}{dY^2} = 0$$

and hence:

$$(6) \quad \frac{d^2k}{dQ^2} = \frac{-[a(X/Y) + b][f_{XX}(X/Y)^2 + 2f_{XY}(X/Y) + f_{YY}]}{[f_X(X/Y) + f_Y]^2}$$

along a vector expansion path.

To determine the shape of an isocline, the function:

$$(7) \quad G = Q + \lambda[k - aX - bY]$$

is partially differentiated with respect to  $X$  and  $Y$  to yield:



$$(8) \quad \frac{\partial G}{\partial X} = f_X - \lambda a = 0$$

$$(9) \quad \frac{\partial G}{\partial Y} = f_Y - \lambda b = 0$$

for maximum  $Q$  for each  $k$ . Total differentiation of (8) and (9) yields:

$$(10) \quad \frac{dX}{dY} = \frac{f_Y f_{XY} - f_X f_{YY}}{f_X f_{XY} - f_Y f_{XX}}$$

which is the slope of an isocline. Substitution of (8), (9), and (10), into (4) gives:

$$(11) \quad \frac{d^2 k}{dQ^2} = \frac{f_{XX} f_{YY} - f_{XY}^2}{\lambda [-f_X^2 f_{YY} + 2f_X f_Y f_{XY} - f_Y^2 f_{XX}]}$$

along an isocline expansion path.

At the point of maximum marginal returns to scale (equally spaced isoquants) *along a vector*, (6) indicates:

$$f_{XX}(X/Y)^2 + 2f_{XY}(X/Y) + f_{YY} = 0$$

or:

$$(12) \quad f_{XY} = - \frac{[f_{XX}(X/Y)^2 + f_{YY}]}{2(X/Y)}$$

Substituting (12) into (11) shows that along the isocline passing through the same point:

$$(13) \quad \frac{d^2 k}{dQ^2} = \frac{-[f_{XX}(X/Y)^2 - f_{YY}]^2}{-4\lambda(X/Y)[f_X f_{YY} + f_Y f_{XX}(X/Y)][f_X(X/Y) + f_Y]}$$

Within the region of diminishing marginal productivity for both inputs and except for the case of the squared term equal to zero, isoquants are still becoming closer together at this point on the isocline and the point of maximum marginal returns has not yet been reached.

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# BOOK REVIEWS

## General Economics; Methodology

*Essays in Economics: Theories and Theorizing.* By WASSILY LEONTIEF. New York and London: Oxford University Press, 1966. Pp. xii, 252. \$6.00; paper, \$2.50.

This collection spans 30 years of writing. Most of the articles are theoretical, but many concern practical problems which were topical at the time. They cover a wide range of subjects and in the main are readable and enlightening, with little mathematics and with an occasional dash of polemics. All that can be done in this review is to discuss some of the more important essays, numbered here as in the book.

II, in a dynamically unstable system the variables grow in absolute value and so do any errors. Leontief suggests that it might be better to test such systems by examining the movements backwards through time rather than forwards. This interesting view, however, ignores two points. Firstly, long-past data are hard to come by. Secondly, the errors only tend to grow at the same rate as the true values so that they do not really become more serious.

III, Samuelson's Correspondence Principle advocates we ignore unstable systems. Then Leontief asks (p. 36) "... how would we go about explaining the rapid and apparently limitless growth of the modern Western economies?" There is a confusion of the concepts of growth and instability here. The equilibrium may be growing over time and yet be stable in the proper sense that the disequilibrium (absolute or perhaps only relative) tends to zero. Economic growth is quite common; increasingly dominant disequilibrium is not.

After a carping attack in Chapter V on what he calls implicit theorizing, mainly by the Cambridge economists of the 1930s, the author pays his respects to Marx in his essay VI. He believes that Marx's accusation of "fetishism" in the Classics' value theory is largely wrong, but that he had valuable if not comprehensive things to say about economic crises. Without accepting his theoretical analysis of long-run tendencies, Leontief praises Marx for his emphasis on real institutions and empirical data and for his breadth of vision.

Part Two (VII) opens with the well-known short 1936 article in which Leontief maintains that the essential difference between Keynes and the Classics is the former's denial of the "homogeneity postulate" in the labor market. In a 1948 essay (VIII), however, he also stresses the importance of the liquidity trap.

IX, Leontief bases his criticism on Patinkin's theory on the contentions that "... using paper money as a medium of exchange" and "Since money does not enter in his utility . . .," the excess-demand functions for real commodities are homogeneous of degree zero in prices and are not independent. To get these results, however, it is necessary to keep money out of the budget equation, and it is not easy to see how this can be done if it is financing trans-

actions. Whether money enters the utility function or not is largely irrelevant to the issue.

X is a 1946 article that shows that astute "take it or leave it" bargaining by one party in a conflict situation leads to an efficient distribution of commodities. Since the other side is not allowed any bargaining power, however, the analysis is not so directly applicable to guaranteed annual wage agreements and bilateral international trade agreements as the author thinks.

XI, the famous 1933 article on "The Use of Indifference Curves in the Analysis of Foreign Trade" shows Leontief at his analytic best. The techniques he helped make standard "... may partly explain the highly developed interchange of commodities between countries with similar industrial structure" and also show how an offer curve is distorted by an import duty.

XII, Leontief's long 1936 article on index numbers was written independently of Staehle's 1935 classic. He demonstrates an ambiguity in the "ideal price index" even when calculated from the point of view of a given utility level. Granted, but this inconsistency can be avoided by first defining the "ideal quantity index" at given prices and then deriving the corresponding price index to satisfy the total expenditure criterion. Even this measure is not perfect, however. For example, consider situations 1, 2 and 3, with prices the same, and income twice as high, in 1 as in 3. With prices in 2 as base, the index of quantity in 1 is higher than in 3 but not necessarily twice as high, and the corresponding price index may show a difference between 3 and 1.

Leontief tries to solve the index number problem by defining the quantity index in terms of fixed proportions among quantities, but this trick has little appeal. This index is imperfect in the same sort of way as the one discussed above. Notice that the proportions are selected arbitrarily. What makes Hicks' analogous theorem on composite goods work is that he assumes that the proportions (between prices) are fixed by the market. Similarly, rigid complementarity among commodities would suffice. Incidentally, if Leontief's general ideas were acceptable, why consider only fixed proportions? The composite basket could be defined by any curve in the relevant space provided it cut continuously higher indifference curves.

XV, in this 1958 article, Leontief attempts to reduce the complicated business of economic growth to a very simple form, but this leads to several unsatisfactory features. In each period, a decision is made to consume so much and to invest so as to achieve some constant stream of future consumption. When the next period arrives, however, consumption is changed, and the decision-makers never learn from their mistakes. Planning for a nonconstant stream of future consumption is not allowed, despite the growth environment. Finally, tastes are assumed never to change. In his reply to a comment by Fred M. T. Westfield, Leontief fails to realize that the indefinite future *does* enter his present utility function, and consequently misses the real difference between his and Frank Ramsey's model, which is that Ramsey allows a free choice of the planned pattern of future consumption to be made in the present decision period.

In XVII, a simple model of growth is used to examine empirically how much aid rich countries need to give to underdeveloped ones to bring the lat-

ter's growth rates up to the former's. Apart from the obvious dangers of oversimplification, the model contains a serious flaw. The growth rate of a recipient country is raised by the transfer of capital, but the donor's income is still allowed to grow as if the transferred resources were invested domestically. Since in fact the aid must slow down the donor's growth, the problem of the gap, as such, is reduced.

This review has concentrated on various criticisms of the more interesting essays. But these are mere minor blemishes when compared with the wealth of insight, technique, and the expository skill which dominate the whole collection. There must be few economists indeed who could not profit from a selected reading (or rereading) from it.

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### Price and Allocation Theory; Related Empirical Studies

*The Theory and Empirical Analysis of Production.* Edited by MURRAY BROWN.  
New York: National Bureau of Economic Research, 1967. Pp. x, 515.  
\$12.50.

In the 1950s Professors Solow, Abramovitz, Kendrick and others presented us with evidence that our knowledge of the factors that have contributed to economic growth is very limited. Their evidence suggested that increases in labor inputs and in the stocks of physical assets have accounted for only a small part of the growth in various measures of aggregate output. Apparently other factors were much more important; unfortunately our knowledge of these other factors and how they influenced production was quite limited. Appropriately these early studies gave rise to an enormous number of studies whose object it was to close this ignorance gap. The object of many studies was to introduce new variables into the production function analysis or to improve the measures of the old labor and capital variables. As a logical complement to these studies other work was designed to develop more general functional forms for use in empirical production function analysis. The now well-known CES function resulted from such work. The early studies made use of existing data, but as work progressed the need to develop new and more appropriate data for closing the ignorance gap became apparent. After roughly ten years of work it is time that we assess the progress that we have made, and to chart a provisional course for the next few years. This book serves this function well, and economists, especially those working in applied econometrics and in economic growth, will find it a useful addition to their library. That some disappointment was expressed in the book concerning the progress to date seems unimportant, for the subject itself (production and economic growth) remains important and an accurate assessment valuable.

After an introduction by the editor, the book opens with a very readable (and enjoyable) chapter by Professor Paul Douglas on the development of the Cobb-Douglas production function. Since Douglas' early work provided a basis for much of the work in the last decade, its inclusion in this volume is useful.

Following these chapters, the book is divided into three parts. Part one contains chapters by Professors R. M. Solow and Marc Nerlove. In his chapter Solow points to a number of developments that may be useful in further empirical production function analysis and points to a number of defects in past studies. The Nerlove chapter represents a comprehensive review and evaluation of the work with CES and related functions; the chapter contains a detailed discussion of the sources of bias in various estimates of the elasticity of substitution. Unfortunately the biases are many and offsetting, and consequently it becomes impossible to identify one set of estimates as being clearly superior to the others, as far as bias is concerned. Though it has been two or more years since this chapter was written, the state of the art as far as CES estimation is concerned remains much the same. Graduate students should find this chapter a useful supplement to their course work in econometrics and economic theory. One minor point, Nerlove's criticism of C. E. Ferguson's work (p. 98) does not seem justified.

The second part of the book presents some new and promising approaches to production function analysis. The chapter by Michael Gort and Radford Boddy presents a refinement of the vintage models by taking account of the fact that new capital and old capital are combined in production, and that old investment does affect the productivity of new in a direct sense. The empirical part of the study makes use of data on the electric power industry and seems to avoid many of the aggregation problems encountered in other studies. The chapter by Murray Brown and Alfred Conrad reports an attempt to explain differences in productivity in manufacturing industries using data on education of the labor force and on research and development. As the authors recognize, it is possible to raise questions concerning the data and estimation procedures used; however, the study is certainly a step in the right direction and the results reported are provocative. The chapter by Zvi Griliches presents tests of the Cobb-Douglas hypothesis and Cobb-Douglas cross section production function estimates introducing productivity variables, such as median age of employees, and proportion of females in the industry labor force. This too is a step in the right direction. The returns to scale discussion (pp. 305-7) is interesting. In the chapter by Robert Eisner some preliminary Cobb-Douglas estimates are reported; McGraw-Hill survey data are used. These data are a pooling of cross-section and time series, and as with other studies discussed above the usual dummy variable techniques seem to have been used to take account of interfirm differences and intertemporal differences. Some preliminary and not altogether successful attempts to obtain direct CES estimates using the McGraw-Hill data are also reported, but these results must be considered obsolete; much progress has been made in the area of nonlinear estimation since 1965. The remaining chapter in part II is a loosely connected three part piece by N. H. Lithwick, George Post, and T. K. Rymes. Ten years ago, when the profession was staring goggle eyed at the results reported by Solow and others this would have been considered an important work; not so today. The bulk of the chapter is devoted to the presentation and discussion of total factor productivity ratios for Canada. The results reported are not especially surprising.

The third part of the book, on production analysis and economic policy, is one short chapter by Richard Nelson. Nelson concludes that so far empirical production analysis has not as yet contributed the detailed sort of information that policy makers might desire. However, to this we might add, policy makers will always be capable of asking us questions to which we do not at the moment have an answer.

MICHAEL D. MCCARTHY

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*The Costs of Economic Growth.* By EZRA J. MISHAN. New York and Washington: Frederick A. Praeger, 1967. Pp. xxi, 190. \$6.50.

This is a passionate book by a concerned participant in modern Western society, a participant who has looked carefully at the present, projected the future, and who does not like what he sees. He is also a professional economist, and the book reflects this emphasis despite its intended presentation to potentially concerned participants generally. As with many polemics, the organization is spotty, but this is more than offset by inspired passages of genuine literary merit. The contrast between this book and the tedium that many economists now produce could hardly be greater.

Two direct quotations will indicate both the flavor and content of Mishan's argument. "Sustained technological advance, . . . , tends inexorably to destroy the sources of satisfaction of ordinary people regardless of the form of economic or social organization" (p. 148). ". . . the invention of the private automobile is one of the great disasters to have befallen the human race" (p. 173). In their zeal for achieving growth targets, measured in values for goods of the standard sort, policy makers have neglected the offsetting proliferation of "bads." The emphasis on quantifiable macroeconomic policy variables is decried, but Mishan's main attention is on the external diseconomies that characterize modern economic and social interaction. In the large, these may all be classified under the congestion rubric. Such problems as motor traffic, airplane noise, air and water pollution, urban sprawl, population explosion, despoliation of natural beauty spots: all of these and others reflect grossly inefficient utilization of scarce resources. Mishan's plea is for a dramatic change in policy direction, even if this can only be accomplished at the expense of slowing down measured growth in national economic aggregates.

A modern growthman should have reviewed this book as a critic of the primary theme. I find myself largely sympathetic with Mishan's central argument as well as with many of the subsidiary strands that are perceptively developed even if many are wholly noneconomic. While I should quarrel with certain applications of externality analysis, these technical criticisms do not undermine my general agreement with the negative or critical features of Mishan's polemic.

Unfortunately, however, the book contains one major flaw. This is, put quite simply, prejudice. Mishan shares this prejudice with J. K. Galbraith, with whose *The Affluent Society* Mishan himself compares this work. Correctly sensitive to much of what is wrong with modern social organization, prejudice against the market order distorts the diagnosis and thereby diverts

attention from potentially effective cures. Mishan remains an old-fashioned Pigovian in his welfare economics, despite his acceptance of modern theoretical refinements, and, as a good Pigovian, he explains all ills in terms of "market failure." The book is liberally sprinkled with snide remarks about "laissez faire economists" and the "excesses of private enterprise." To the unwary reader, these would be interpreted to be the sources of the difficulties that are so starkly exposed.

The failure here is surely one of "government" not the "market" or "private enterprise." Until this is recognized there seems little or no point in berating "laissez faire economists." Since Frank Knight's critique of Pigou's crowded-road example, these economists have at least understood the sources of congestion problem, something that could scarcely be said of their socialist counterparts. Mishan screams for reforms; but he neglects analysis of why governments, almost universally, fail to organize the usage of *public* properties in even tolerably efficient ways. Road-street usage is only the most ubiquitous of the many manifestations of congestion. But is there a nation, state, province, or local community in the world that operates its *public* road facilities with a modicum of efficiency? In almost every specific case cited by Mishan, or earlier by Galbraith, the despoliation arises from a failure of government to establish and to enforce property rights in scarce resources. This is not, of course, so say that the establishment of individual or private property rights in the ordinary sense is the most desirable means of securing efficiency in each instance. The relevant point to be emphasized is that the horrible examples really show almost the opposite of that which is implied by the discussion. They indicate that the market order works where property rights are identified and policed; it is where this basic function is *not* carried out by government that we observe most of the "bads" of modern society.

The constructive complement to Mishan's negativism should be, and must be, hard-headed analysis of collective decision processes. (Harry Johnson made essentially this point in his *Spectator* review of Galbraith's *The New Industrial State*.) This tends to be overlooked if the "bads" are attributed simply to "market failure" which the presumably benevolent government will fix up once it becomes informed and properly interferes. Only when the "bads" come to be labelled, not as market failures condoned by those monsters, the laissez-faire economists, but instead as gross omissions of collectivities, will concerned participants (economists and others) begin to seek explanations for paralyzes of group decision processes. I hope that accentuation of the negative, especially in such passionate tones as those of Mishan, will be followed by informed, careful, and unprejudiced analysis of the institutions of public choice. Only when these institutions are better understood can elimination of the most obvious "bads" be expected. And, as Mishan acutely senses, by that time it may be too late.

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*Microeconomic Analysis*. By CLIFF LLOYD. Homewood: Richard D. Irwin, 1967. Pp. xi, 273. \$7.95.

This price theory text is presumably intended to be a substitute for both, say, Ferguson from the same Irwin series as well as Henderson and Quandt from the McGraw-Hill handbook series. I say "presumably" because its style of presentation is a curious mixture of the low-brow literary-graphical presentation of Ferguson with the middle-brow mathematical presentation of Henderson and Quandt (here the last mostly reserved for appendices but constituting over one-third of the book). As a teaching technique it is clearly dominated by some convex combination of these two (if not by either of them alone), for reasons that I shall try to make clear.

The topics covered are fairly standard and comprise (i) the theory of consumer behavior, (ii) the theory of competitive, monopolistic, and oligopolistic firm behavior; partial equilibrium of product markets, (iii) factor demand curves; partial equilibrium of factor markets, and (iv) general equilibrium in both a pure trade and a production economy. These are reasonably competently done with some obvious exceptions. In particular two of the exceptions merit explicit comment: The relation between production technology and cost functions is, to say the least, very loosely explored. In fact, at one point (p. 113), after giving a heuristic argument to support the initially concave, eventually convex total cost curve, the author simply says "It is conventional in microeconomic theory to draw total cost curves with this shape." While it is true that on the next page Lloyd makes clear that he is aware that this is a rather peculiar way to justify a model, the fact remains that such nebulousness is just what explicit theory is designed to eradicate.

A second exception occurs with respect to the discussion of general equilibrium. This is simply that nowhere does Lloyd bring out what I take to be the central point of general equilibrium theory, namely, that efficient or Pareto optimal allocation is inextricably tied up with precisely the prices and behavior that emerge from a competitive equilibrium (the point so nicely made in Bator's *AER* survey article or Koopmans' first of *Three Essays*). Lloyd does mention the Pareto optimality of competitive equilibrium; it's just that that's all he does in this direction. Indeed, his general equilibrium model (pp. 238-49) has monopoly elements in it! (And please don't ask how one justifies partial equilibrium noncompetitive behavior in a general equilibrium context.)

The principal criticism of the book's coverage has to do with what's left out rather than what's included, however. This criticism is of two sorts: First, none of the conventional "stories" (which, I think, effectively suggest the potentially wide applicability of price theory) are presented. For example, in the discussion of consumer behavior, the reader sees nothing about the distorting influence of excise taxes, the welfare implications of alternative indices, or the possibility of backward bending labor supply curves. Second, and probably more serious, a number of important topics are not even mentioned. Among these, the most glaring omissions were consumer behavior under uncertainty, consumer or firm behavior over time, linear programming (e.g., in motivating the increasing, linear homogeneous production function by deriving it from a



production activity model) and the difficulties for decentralized allocation entailed by nonconvexities (e.g., increasing returns to scale) or nonmarket interdependencies (e.g., public goods).

There is a very wide divergence between the two styles of presentation in the book. In utilizing the book one simply couldn't avoid facing up to this divergence, either, as some of the basic stuff of price theory appears only in the mathematical sections (e.g., the definition of an inferior good appears in a footnote to the mathematical appendix of Chapter 1). Furthermore, the divergence is in a sense wider than that between the styles of, again say, Ferguson or Henderson and Quandt, basically because Lloyd jumps right into the  $n$ -dimensional case in his mathematical discussion. What is really gained by going from an emphasis on 2-dimensions to an emphasis on  $n$ -dimensions (where the dimensions refer to the number of consumption goods, the number of factor inputs and so on) in comparative statics? In the theory of consumer behavior, for example, all that is gained from the generalization is the possibility of complementary goods. Moreover, there is some hope of being able to teach relatively bright but immature students the mathematics necessary for the special but not the general case. (Anyone who might believe that the student can learn the latter from Lloyd's summary had better look again as, for instance, the student would find on page 39 that "A function of several variables does not always possess a unique single derivative, rather has it several partial derivatives," on page 47 a fairly obscure expansion of the determinant justified as being "well-known" by reference to a book of 1892 vintage, but nowhere in these pages even a hint about the implicit function theorem.) For this reason alone I will continue to use Henderson and Quandt for the mathematics in a price theory course as for the most part it does emphasize the 2-dimensional case. Whether the calculus approach to the structure of price theory is the best analytic approach is surely the wider question raised by this sort of text, but going into this question here would take me too far afield.

Finally, let me summarize by repeating that I think this text is clearly dominated by several others available, whether the course being taught is low-brow, middle-brow, or a mixture of the two.

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### **Income Theory and Related Empirical Studies**

*Golden Rules of Economic Growth: Studies of Efficient and Optimal Investment.* By E. S. PHELPS. New York: W. W. Norton, 1966. Pp. xv, 189. \$6.95.

Professor Phelps is one of the discoverers of the Golden Rule of GR path, which he originally defined as the consumption maximizing golden-age path, i.e., only with respect to golden-age models. In this collection of 12 essays, he extends his analysis of the meaning of the GR concept, and applies it in various ways to both golden-age and non-golden-age models.

The book is divided into three parts. Part 1 deals essentially with the

non-golden-age models; parts 2 and 3 refer exclusively to golden-age models. Part 2 defines the GR path in relation to absorption difficulties, embodied technology and an invention possibility frontier. Part 3 extends the application of the GR concept to models which deal with investments in non-capital goods, such as research, education and even human beings (the "GR of Procreation").

The seven essays of Parts 2 and 3 are stimulating; they contain a number of original and interesting ideas, although a mathematician would sometimes like them to be more rigorously formulated.<sup>1</sup>

My reaction to Part 1 is, however, less favorable. It seems to me that Professor Phelps's analysis omits one of the most important properties of the GR path, namely, that it is what I have called a *critical path* [1]. In terms of capital  $K$ , a critical path is a path, say  $\tilde{K}(t)$ , not itself necessarily feasible, which has the two following properties:

(i) Every feasible  $K(t)$  which satisfies

$$K(t) \geq (1 + \epsilon)\tilde{K}(t), \quad T \leq t + \infty$$

for some  $\epsilon > 0$  and  $T > 0$  is efficient.

(ii) Every feasible  $K(t)$  which satisfies

$$K(t) \leq (1 - \epsilon)\tilde{K}(t), \quad T \leq t < +\infty,$$

for some  $\epsilon > 0$  and  $T > 0$  is efficient.

Phelps's stresses (i), but neglects (ii). This is why he introduces the Quasi-GR or Q-GR path. I find this path rather superfluous, since there is generally an infinity of less inefficient paths which also satisfy (i); moreover, a given growth model is likely to have an infinity of Q-GR paths (if any).<sup>2</sup>

Phelps's Generalized GR or GGR path is more interesting because it is a critical path in the sense of (i) and (ii), and therefore a priori useful in dynamic efficiency analysis. In general, however, it is not only a rather complicated path, but the set of parallel paths relative to which it is consumption maximizing is of no particular interest. I, myself, prefer the economically more relevant concept of the GR Strategy or GRS which equates the growth rate of capital to its marginal product at all points of time [1]. This is a critical strategy in the sense that the feasible path it defines is a critical path. However, the latter can hardly be considered as a true generalization of the GR path.

A more natural generalization of the GR path refers to models which are asymptotically capable of golden-age growth. These models are characterized by the fact that capital, production, and consumption tend to grow exponentially at the same golden (equilibrium) rate, provided only

<sup>1</sup> This remark applies to the essay on the "GR of Research." The definitions of diminishing returns, diminishing marginal rate of substitution, technical progress in research and marginal-effectiveness function are ambiguously defined and this makes the subsequent analysis mathematically unclear.

<sup>2</sup> Let  $F = F(e^{\mu t}K, e^{\lambda t}L)$ ,  $k = (K/L)e^{m(\mu-\lambda)t}$  and  $f(k, e^{(1-m)(\lambda-\mu)t}) = (F/L)e^{(1-m)\mu t + mt}$ . Then, the path  $k(t)$  which satisfies  $e^{\mu t}f_k = (L/L) + m(\lambda - \mu)$  is a Q-GR path for every given  $m \geq 0$  and  $\leq 1$ .

that the savings ratio is maintained constant and positive over a sufficiently long period of time.

These "quasi-golden-age" models include practically all models which are relevant in the context of long-term growth and, consequently, of dynamic efficiency analysis. Each one uniquely defines a set of exponential and parallel "growth" paths which are, in relative terms, ultimately reachable by a feasible path. This set of ultimately reachable golden-age paths contains generally a consumption maximizing path which I call (Ultimately) Reachable GR or RGR path [1]. This path is both exponential and critical, like the GR path, and coincides with the latter in golden-age models. Moreover, in the case of quasi-golden-age models, it is asymptotically identical with the GGR path. Finally, in the Ramsey problem, the RGR path plays the same role under quasi-golden-age assumptions as the GR path under golden-age assumptions.

With regard to Phelps's "fundamental notion" of a commanding path I must admit that I find it confusing. The concept of dominance is a mathematical concept: One says that the function  $x_1(t)$  dominates the function  $x_2(t)$  over  $0 \leq t < +\infty$ , if both  $x_1(t) \geq x_2(t)$ ,  $0 \leq t < +\infty$ , and  $x_1(T) > x_2(T)$  for some  $T \geq 0$ . Hence,  $x_1(t)$  is dominant in a given set of functions defined over  $0 \leq t < +\infty$ , if it dominates every function of this set. Now Phelps: (a) restricts unnecessarily the concept of dominance to consumption-dominance, and (b) seems to think that the concept of dominance changes depending on whether or not the set to which it is applied is restricted to feasible paths. Notice that his terminological distinction between a commanding and a dominant path is rather useless, even as shorthand notation. Indeed, this distinction does not avoid the necessity of specifying the set with respect to which a given path is either "dominating" or "commanding."

The above criticisms concern essentially three out of the five essays of Part 1. I find the paper on Factor Augmenting Progress very interesting and clear. The paper on the Ramsey Problem provides a good introduction to the subject, even though parts of it are somewhat obsolete. For instance, it does not mention the fact that the existence condition,  $\rho \geq (1+E)\lambda$ , is equivalent to the requirement that Euler's solution be efficient [2]. It thus fails to reveal an interesting link among the GR path, dynamic efficiency analysis, and the Ramsey problem.

To sum up I find Phelps's book uneven in quality. It contains many interesting and stimulating ideas. It is well written and its mathematics are very simple. Unfortunately the book fails to achieve one of its acknowledged objectives, the generalization of the GR concept to non-golden-age models.

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2. ———, *Towards a Realistic Theory of Optimal Growth*, Contributions to Economic Analysis, North-Holland Pub. Co. (forthcoming, tentative title).

*Essays on the Theory of Optimal Economic Growth*. Edited by KARL SHELL. Cambridge: Massachusetts Institute of Technology Press, 1967. Pp. xii, 303. \$12.50.

With some exceptions, these fifteen "Ergebnisse eines M.I.T. Seminar's" are exercises in the Pontryagin technique of optimal control. As such they were not only useful to the authors who performed them but also to the reader who wants to learn how to do these things for himself. It would be quite wrong to dismiss them as "mere exercises" with uninteresting models until one has tried to do the trick for oneself. This should quickly persuade readers that they have something to learn.

It is of course not possible to give detailed attention to each of the papers here. Instead I propose to offer some general comments of relevance to a whole group of the essays and then say something more specific about one or two of the others.

Very little is said by any of the authors about the choice of maximand. Indeed there is something of an unseemly haste to get down to the Hamiltonian. But it is not true that the valuation question throws up no interesting technical problems or that it must always end in inconclusive metaphysics. For instance it is instructive to construct extreme examples of technologies, etc., to test the reasonableness of say the "Benthamite" social value function, and there are interesting things to say on the question of additivity. Apart from this one is much put off by wide use of a valuation function linear in consumption per head (Shell, Nordhaus, Bruno), although this is sometimes rectified in an appendix. Not only is there nothing to be said for such a valuation, but it sometimes confuses the issue. Thus in the splendid paper by Bruno where the production set is a finite cone, one cannot without additional work be sure whether a particularly odd phase of the optimum trajectory is due to the technology or the silly valuation. The desire for concrete results seems no excuse for asking us to contemplate with equanimity long stretches of time where no one eats at all.

Lastly in this connection, it is worth noting that none of the authors shows any interest in the puzzle of who is supposed to do the valuing. Twenty years ago this was at the center of interest to welfare economists. In the optimum accumulation context, this problem gets a peculiarly interesting twist. For even if we opt for a dictator, he cannot opt for immortality. Should one not enquire into the course of rational action with consequences into the far future, when the valuation of one's successors is not known?

Once one has chosen a maximand, one looks for a problem. Shell chooses one- and two-sector neoclassical models with exogenous technical progress, Sheshinsky allows learning by doing, Nordhaus is concerned to choose the

best innovating activity in the context of a Kennedy-Weizsacker model, Ryder investigates the optimum trade of a country facing a less than perfectly elastic demand for its exports, Bardhan, the optimum policy for foreign borrowing, (with foreign assets per head entering negatively into valuation), Chauduri considers an investment transportation model in a two-region economy and Chase the optimum choice path for leisure and consumption in a Ramsey model. Bruno, as already mentioned, studies an economy with a "finite spectrum of techniques" and Marglin the problems of a simple labor surplus economy. These last two papers have the most economics, and to me were by far and away the most interesting of the group just mentioned. It is not that the other papers were not very well done. It is simply that one's interests are more engaged by exercises with "relevance potential" than by those without.

Marglin's paper is not really concerned with Pontryagin problems at all. He considers a world which is forever in labor surplus and where the choice of technique must be once and for all. Since labor must be paid a subsistence wage, the choice of technique determines the investible surplus. If we choose a technique employing one extra man the gain is the current marginal social valuation of the subsistence wage. The loss is the fall in the maximum (present value) of all future utilities due to the reduction in investible surpluses (and so power to employ labor), if the wage exceeds its marginal product. The latter must be true for an optimum path where loss and gain are equal. This leads to a simple and appealing investment criterion. To "Pontryaginise" this problem (recently very nicely done by Dixit), we need to allow a continuous choice of techniques and also the possibility that capital accumulation will catch up with the labor supply. But we know in advance what will happen. When the capital stock is sufficiently high just to employ all labor, we shall not in general wish to do so, because then there would be nothing to invest in the future and we are in general willing to trade some current for more future consumption along a path of steady consumption. Hence full employment will only take place when it is consistent with some surplus. Thereafter we are in familiar waters.

This leads me to the second general point I wish to make. Many of the most interesting qualitative conclusions come from the Maximum Principle directly and not from the detailed computation of the path. This is true for instance for the optimum subsidy for learning by doing, for the tax on foreign lending when the returns depend on the amount done and on the relationships between various own rates. Moreover it is known that the singularity (if there is only one) in the space of the state and shadow price variables is a saddle point or totally unstable. All this is a lot of information, without computing in detail the various phases of the optimum trajectory. The latter is not only tedious, but also hard to do when the phase space has more than two dimensions. Is it worthwhile restricting oneself, as so many papers in this volume do, to just those simple models which allow one to draw the optimum trajectory? And if so, should we have not been given some guidance how to compute an actual path?

The only paper in this series where the various phases of the optimum trajectory were not fairly obvious is Bruno's. For he investigates the question,

admittedly in a restricted context, of whether on an optimum trajectory the economy will encounter "double switching," and finds in the negative. This is a very nice result and it is to be hoped that we shall soon also have the answer for more general cases. (He also makes good use of the "saddle point" property mentioned above.) But this is the exception; elsewhere we are not surprised that the linear valuation function leads to phases with zero consumption or that in a two-sector model with fixed techniques similar extreme phases may occur. Our intuition by now is sufficiently well developed to be able to deal easily with cases where either the valuation or the constraint set is not strictly concave.

The last general point to be made is this; although some of the papers discuss the question of taxation policy (e.g., Sheshinsky, Bardhan) required for an optimum path, it is fair to say that most of the authors are not interested in the question of available instruments. Thus no one tells us how the economy is to be made to save the optimum amount each time, nor how we are to direct its investments in the right directions. These are clearly questions at once of some importance and relevance to the topic under discussion.

Finally in connection with this group of papers there is a slight technical puzzle. Without exception they use the Pontryagin Principle, which is known to be necessary but not sufficient for an optimum. But for many of the problems a straightforward "Kuhn Tucker" approach (integrating by parts) and the transversality condition give both a more familiar and more direct line of attack. It is odd to find that none of the authors shares this view.

The volume also contains papers not directly concerned with detailed optimum policy in particular models. Cass and Yaari in an exceptionally fine paper discuss the problem of Pareto efficiency and optimality in the context of a model with "life time saving." A related piece of work by Meade appeared too late for them to consider. In such a world there are in general a number of possible steady states, some with an interest rate below its golden rule value. It is easy to show that, whatever the rate at which households discount future utilities, the golden rule rate of interest will ensure flow equilibrium; i.e., savings equal to investment. However, except for a fluke the economy will not be in asset equilibrium at the golden rule, while for all other steady state interest rates, asset equilibrium is assured. (From the budget constraint:  $w + ra = c + na$  in steady state, where  $c$  is consumption per head,  $w$  is the wage,  $a$  is assets per head and  $n$  the growth rate. In flow equilibrium  $w + rk = c + nk$  where  $k$  is capital per head. If  $r \neq n$  so  $w \neq c$ ,  $k = a$ .) It is thus possible that the steady state will have more than the golden rule capital per man, a state of affairs we know to be inefficient. Cass and Yaari show that if into this economy another nonproductive asset is introduced, and some of it is held in steady state, then the latter is efficient. (They invoke an efficiency criterion developed in the appendix.) They think of this extra asset as money, but since apparently it has no role in mediating transactions, this must be taken as poetic licence, although there is no doubt that they have discovered an argument which will find its place in an eventual monetary theory of the future.

There is however an important difficulty with the foregoing analysis. Cass

and Yaari are concerned with competitive growth equilibria consistent with perfect foresight on the part of agents. To demonstrate this for arbitrary initial conditions and many sectors may be difficult. But one conjectures that it will be possible in those cases where one can make use of Kurz's suggestion and view the economy as if it were maximizing some Ramsey integral. But this in turn has a serious drawback. Since individuals have finite lives and leave no bequests, they formulate expectations over their lifetime only. If the Kurz procedure is possible then there is only one set of expectations out of innumerable others, on the part of the first generation, which will allow a competitive path to fulfill the expectations of all future generations. It is hard to take seriously the view that the first generation will hit on these. Thus even if all infinite competitive growth equilibria have asymptotic balanced states (p. 248), it is quite exceptionally heroic to suppose any economy to be in such an equilibrium.

Matters related to the foregoing are discussed in two papers by Samuelson. In the first he discusses the problem raised by myself that, in a world with heterogeneous capital goods, equilibrium paths with myopic foresight do not in general converge on the steady state and that initial expectations have to be specified arbitrarily. In doing so he shows that he understands the economics of the problem much better than I did and makes an ingenious suggestion for proving this sort of proposition for Neumann models with *some* savings proportional to income. His conjecture (p. 226) that the steady state will always be a saddle point however does not seem correct for a descriptive savings function. It is true that the intertemporal efficiency conditions strongly point to this but the rule-of-thumb saving behavior makes it not possible to prove such a pleasant result. In his second paper Samuelson shows that if the valuation function values not only consumption per head but also the number of heads ( $LU(C/L)$ ), then for any finite program, the optimum path will be near the path where capital has a zero marginal product, and since population is growing, the capital stock for most of the time will be in excess of its golden rule value. I am not clear why he calls this a "refutation" of the view that a path which permanently has more capital than the golden rule amount is inefficient. This latter theorem is of course not meant to enable us to recognize any past path as inefficient, but rather to prevent us formulating bad plans for the indefinite future. As such it is probably not of great practical significance, but it seems worth having.

The book concludes with a technically very able proof by Akerloff that the equilibrium paths of a single-sector putty clay model converge on the steady state.

This review, fairly long though it has turned out to be, cannot take account in any satisfactory way of many felicities of analysis of individual authors, for instance the ingenious procedure adopted by Nordhaus to deal with quite a hard-looking difficulty. Nor is there space to document such views as that two-sector models are best analyzed by means of the dual (unit cost) functions and that even then they are probably not worth the effort. But I hope enough has been said to show that, whether one approves of individual con-

structions or not, this is a most stimulating and useful book and that it contains some things which are first rate and important.

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### History of Economic Thought

*The Years of High Theory: Invention and Tradition in Economic Thought 1926-1939.* By G. L. S. SHACKLE. Cambridge: University Press, 1967. Pp. viii, 328. \$7.50.

The 1930s clearly represent a vintage period, a really great burst of creative activity in economic theory. Professor Shackle's latest book undertakes a review of that period and succeeds in transmitting its excitement to the reader. In short, the author has produced another work meeting the high standards we have come to expect of him.

The book deals with five areas of theoretical innovation: imperfect and monopolistic competition, indifference-curve analysis, the formal dynamics of Harrod, Frisch and Samuelson, the Leontief input-output analysis and, of course, the Keynesian Revolution. It is only just that the bulk of the volume is devoted to the last of these. On each of these topics Shackle provides us with a discussion of forerunners, he describes the accomplishments of the new theory itself, and (throughout) offers a variety of penetrating observations and comments of his own.

Though the discussions of predecessors are illuminating and often call to the reader's attention materials of which he was previously unaware, the author makes no attempt to be exhaustive. In the case of the central ideas of the Keynesian analysis, an attempt at a reasonably comprehensive analysis of forerunners would clearly be hopeless at least within the confines of such a slim volume. Nevertheless, the author manages to provide a variety of most interesting materials even here. For example, he brings to our attention a discussion in 1896 of Kahn's multiplier analysis by Julius Wulff, a member of the Danish Parliament, and one by N. A. L. J. Johannsen, a German writer, in 1898. In the process, Shackle also manages to give us some feeling for the human emotions that go into the process of discovery, recording for example Kalecki's reaction when he arrived in England in 1936 only to find that Keynes had anticipated his ideas—"For three days I felt ill," Kalecki recollected.

Shackle's rather careful report on earlier writings on monopolistic competition does, unfortunately, suffer from one serious omission. Professor Viner's contribution is overlooked altogether; not only the discussion of marginal revenue in the noted 1931 article "Cost Curves and Supply Curves," but also his very detailed analysis of product differentiation (in which he makes explicit use of the term) in a paper written in 1921 [1].

One can quibble on other matters, occasional minor theoretical slips, but it is surely unworthy to labor such trivial shortcomings of which no work can be



completely free. On only one substantial matter do I take issue with the author. Shackle makes a great point of what he considers to be the central premise, "the very bed rock" of the Keynesian model. He tells us again and again that the critical element in the analysis is its recognition of uncertainty and its consequences for expectations. I am most unhappy with any attempt to identify *the* central premise of such a complex body of analysis. A theoretical model must rely on a number of conditions which are necessary for its functioning. It is all too easy to single out some one of them as the critical contribution, but the process must remain inherently arbitrary. This comment applies, for example, to those who have suggested that stickiness of wages is the key element in Keynes, and it must for similar reasons be relevant for Shackle's candidate for the post.

But we must get back to the central matters of the volume, and not lose sight of Shackle's accomplishment in redirecting our attention to a period of great theoretical contributions. The waves of productivity that have characterized the history of economic analysis are indeed rather remarkable—the classical period, the period of the marginal revolution and of the birth of general equilibrium analysis, and then the period of Shackle's book, the very fertile era that spanned the great depression. This last period in fact extended beyond the time examined in the volume, and included such exciting postwar developments as activity analysis, much of the theory of econometrics as we know it today, and the theory of games. It seems equally clear that this outburst of discovery has come to a halt in the last one and a half decades in which much useful work has been done, but most of it hardly revolutionary. Since we do not understand the origin of the waves of creativity, it is probably fruitless to speculate on the likely duration and causes of what we may term (perhaps to comfort ourselves) today's era of consolidation. Yet one cannot help wondering sometimes whether the evolution of our teaching methods over recent decades does not bear part of the responsibility. Perhaps there is a trade-off between rigor and creativity on a grander scale and, if so, we may want to consider whether we have gone too far in one of these directions.

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#### REFERENCES

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*Economics and Ideology and Other Essays—Studies in the Development of Economic Thought.* By RONALD L. MEEK. London: Chapman and Hall, Ltd.; New York: Barnes & Noble, 1967. Pp. ix, 227. 40 s; \$7.25.

In this volume Ronald L. Meek, Tyler Professor of Economics at the University of Leicester, presents a selection of a dozen essays that he has written since 1950 on a broad range of topics in the history of economic thought. The

book is an especially welcomed contribution since it makes these essays more accessible to a wider professional audience.

The relationship between economics and ideology is the general theme that Meek chooses for the book as a whole. As would be expected, the title essay focuses the most intensively on this theme. The other essays reveal concern with the same relationship, though to lesser degrees. Meek believes that ideological and analytical elements are both present in the corpus of economic thought and that some sorting-out of the two is not only possible, but also necessary. On the question of the relative strength of the ideological component, Meek stands somewhere between J. A. Schumpeter and Joan Robinson. He believes, along with Schumpeter, that the sorting-out process requires conscious effort, but does not believe, as does Schumpeter, that the process is automatic. Meek writes: "We cannot safely leave it to history to purge our economics of ideological distortions" (p. 209). Thus, for Meek, ideology is more pervasive and more complexly intertwined with economic theory than for Schumpeter. Moreover, Meek believes that to explain change in economic analysis (such as the transition from the labor theory to the marginal utility theory) "*exclusively* in terms of internal development, as Schumpeter tends to do, is to explain very little" (p. 209). In contrast to Joan Robinson, who says that "reason will not help" to stamp out ideological distortion, Meek believes that progress can be and has been made, but recognizes that the creation of an ideology-free economics is not an easy task (p. 223).

Meek arranges the essays into three main divisions: I, "Classical Economics" (five essays, 92 pp.); II, "Marxist Economics" (four essays, 68 pp.); and III, "Modern Economics" (three essays, 64 pp.). For purposes of review, I first would like to discuss Meek's Marxist essays and then look at most of the remaining essays.

Four essays appear in Part Two of the book under the heading "Marxist Economics." These include Meek's now well-known "Some Notes on the 'Transformation Problem'," as well as individual studies on various aspects of Marxist literature: Marx's economic method, the doctrine of increasing misery, and the falling rate of profit. On the whole, these four essays focus more on logic and analytics and less on ideology than do the other essays in the collection. With but slight redefinition of the boundaries of "Marxist Economics," other essays could have been included in Part Two. For example, his essay on the eighteenth century Scottish writers ("The Scottish Contribution to Marxist Sociology") deals with the early concepts of class structure, stage in social and economic development, and the dependence of the social system on the "techno-economic base" of the community. Meek goes on to argue that the Scottish writers provided basic ideas on these topics to which Marx felt heir. Meek's interpretative review of P. Sraffa's *Production of Commodities by Means of Commodities* might also have been included in Part Two, since Meek considers the book to be a "rehabilitation" of classical economics, and "up to a point," of Marxist economics as well.

Four of the remaining essays can be divided, according to the author's approach, into two groupings. One such grouping, which might be termed "th

critical essay," takes the form of a broad-ranging analysis focusing on one or more books. The title essay, "Economics and Ideology," compares and contrasts J. A. Schumpeter (*History of Economic Analysis*), Joan Robinson (*Economic Philosophy*), and Oscar Lange (*Political Economy*), on the question of the role of ideology in economic theory, particularly value theory. "The Rehabilitation of Sir James Steuart" was occasioned by the appearance of S. R. Sen's *The Economics of Sir James Steuart*, which Meek uses as a springboard for his discussion of Steuart's role in the history of economic thought and of the danger broached by modern "rehabilitators" in possibly losing all sense of perspective when interpreting a past theoretical system in terms of modern theoretical categories. Meek emphasizes in the essay on Steuart that the study of the history of economic thought should "start by relating the major theories that have been put forward to the different phases of development through which the system of market exchange has passed" (p. 17). The second set of essays might be termed "the interpretative essay." Use of a big canvas that allows the author to handle broad themes and make provocative generalizations is characteristic of "The Decline of Ricardian Economic Theory in England" and "The Place of Keynes in the History of Economic Thought." In the first of these two essays, Meek examines the hallmarks of "Ricardian" economics in order to "define those parts of Ricardo's theory which did in fact fall into abeyance after 1830" (p. 55). And in the second of these essays, Meek views Keynes' contribution to economic thought in the context of the relationship of classical and Marxist economics to *The General Theory*.

Meek's book, on the whole, draws heavily on Marxist economics and on Marxist economic, social, and philosophical constructs. This emphasis is indicated by the four (or six) chapters on Marxist economics, and is also revealed in Meek's concern with value theory, class structure, and, of course, ideology. Professor Meek's early interest in value theory (cf. his book, *Studies in the Labour Theory of Value*, 1956) shines through at numerous points in this volume. While Meek employs Marxist categories, his essays are free of ideological dogmatism. For this reason, as well as for the high level of scholarship and the lucid exposition of ideas in the essays, I believe that the volume will be well received by the specialist in the history of economic thought and by the general economist as well.

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*The Trouble With Marx.* By DAVID McCORD WRIGHT. New Rochelle, N.Y.: Arlington House, 1967. Pp. 192. \$5.00.

The trouble with David McCord Wright is that he is still writing cold war tracts, when most of the economics profession has turned to more scholarly endeavors.\* He says in the preface that he "is a believer in capitalism," and "the faith of the true believer has little room for objective analysis of oppo-

\* *Editor's note:* This review was written before knowledge of the death of David McCord Wright on January 6, 1968.

nents." Furthermore, he admits in the preface that he "will deliberately omit details" and "will furnish a simplified book about Marx." This is an understatement of his crude, hardly recognizable, caricature of Marx's ideas.

Following these precepts, the book has no index, less than ten footnotes, and very few quotations. The organization is illogical and sometimes imperceptible as Wright jumps in one paragraph from philosophical concepts to economics and back to philosophy. It is hard to isolate a specific argument, not only because they flow together, but because his attacks are largely by innuendo or are red herrings thrown at straw men. Furthermore, he reserves his strongest attacks for non-Marxist social democrats, Keynesians, and all other "planners" who would subtly lead society away from pure capitalism.

To the extent that he meets Marxist theory head on, his main points concern (1) Marx's historical approach, (2) the withering away of the state, (3) the falling rate of profit, and (4) imperialism. On the first point, he attributes to Marx the crude theory "that technology determines economics, and economics determines history." Yet all Marxist writers, from Marx onwards, discuss technology only as one interacting part of the economic base, often being held back for centuries by the relations of production, as in Roman slavery. And all but the most vulgar Marxists emphasize that the entire economic base is in a functional relation with the social superstructure, determining, but also being determined at any given time.

A great many pages are spent arguing that even in a communist utopia the state could never wither away because even unselfish men, who are in agreement on ends, can come to blows on means. Leaving aside this distant and hypothetical society, Wright says almost nothing about the important and presently relevant question: is a socialist economy likely to produce more or less political democracy than a capitalist economy?

The strangest part of the book, however, is the economic section. It centers around the theory of the falling rate of profit, which Wright claims to be "at once the main base of Lenin's theory of imperialism and of Marx's theory of capitalism's inevitable end." That, however, is a vast overstatement. Lenin never mentions the falling profit rate theory in his long pamphlet on *Imperialism*. Marx uses many other economic arguments, and certainly does not believe in a purely economic or mechanical failure of capitalism; rather, Marx emphasizes the very social trends that Wright claims he ruled out. Many modern Marxists, such as Baran and Sweezy in their *Monopoly Capital*, even argue that the rate of profit has a long-run tendency to rise, and that this tendency is related to imperialism and the end of capitalism.

An additional trouble with Wright is his confused explanation of why the rate of profit falls. He has Marx arguing that capitalist competition causes "higher wages and lower prices." This is quite foreign to Marx's explanation, which focuses on a rising trend in capital intensity, and even mentions *lower* wages as an offsetting factor.

Lastly, Wright attacks Lenin's notion of the economic basis of imperialism, and argues instead a quaint version of the white man's burden. Thus, the British East India company did not desire political domination to protect its plunder of India, but rather made war or annexed territory only in order to

restore order. "In fact, in order to bring industrial progress to all of the underdeveloped countries, it was necessary at first to have a certain amount of juridical order imposed from outside. How else could democracy and progress have reached Africa and Asia?" Wright's theory of inferior colonials aided by altruistic imperialists seems a strangely naive bit of racial mythology in the present day.

It is impossible here to list all of the misinterpretations of Marx in the book, but mention must be made of the biographical sketches at the end of the book. These charming portraits inform the reader that Marx was "insanely vindictive" and "boorish," that Lenin was "ruthlessly powerhungry," and that Engels authored several "fairly flatfooted" works. One wonders why Wright stooped to make the ten thousandth attack on these inferior intellects.

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*Politische Oekonomie—Geschichte der wirtschaftspolitischen Ideen von Platon bis zur Gegenwart.* By EDGAR SALIN. Tübingen: J. C. B. Mohr (Paul Siebeck), 1967. Pp. viii, 205. DM 16; paper, DM 12.50.

This volume, published in memory of the once famous cycle theorist Arthur Spiethoff, presents the fifth edition of a book which made its first appearance in 1923. Main theme of the different editions has been the relationship between theory and empiricism, cultivated by the author conspicuously in favor of the philosophical, historical, almost humane approach to economic problems with economic analysis having little chance to develop. To Salin, economic science is "political science." The political element in economics, he maintains, is to be recognized particularly nowadays when people like to hide behind apparently unpolitical formulas and "scientific" reassurances.

The work is classified in four parts: I. Prehistory (*Vorgeschichte*), treating the Grecian and Roman contributions to economic thought; II. History (*Geschichte*), encompassing mercantilism, the "political science"; physiocracy and classicism, the "systematic sciences"; and socialism and historicism, the "evolutionary sciences." Section III discusses what it commonly called modern economics. In the Excursus some of the well-known contributors to economic thinking are grouped together according to their similarities or differences in methodology. Describing the economics of the ancient world (Metaeconomics), Salin consults mainly political and ethical writings of the old writers instead of using more realistic material. Consequently, he actually reinforces the fictitious undertones of Grecian economic thinking when he is trying to clarify it. On the other hand, Aristotle's economic concepts which have fertilized later developments of thought and therefore offer themselves as basis for a more objective evaluation of the Grecian contribution are not appreciated at all by the author. The Middle Ages (*das katholische Europa*) are treated in approximately the same manner as we find them in usual textbooks. It speaks for the philosophical-speculative attitude of Salin when he emphasizes, perhaps overly so, the interesting value concept of the medieval school that "things are not valued according to the dignity of their natures." It may have been the timeli-

ness of this quasi-socialist notion which was on the author's mind, the idea that "just" price is a matter concerning the whole community, and is not merely the result of evaluations between buyers and sellers. In defining mercantilism as a "system of national power," Salin follows Schmoller's subcutaneous diction. In the same breath he unduly claims a mercantilist economic theory, one that was concerned with "historical and political relationships" similar to F. List's perception in his theory of productive forces. No mention is made of newer interpretations which accept that mercantilism actually recognized and wanted to make the motor of self-interest work to foster economic growth. The physiocrats are criticized for interpreting the dynamics of economic forces as being basic, natural, eternal. To Salin, economic forces are historical phenomena (*anschaulische elemente*). Adam Smith is censured for being mechanistic; Malthus and Ricardo for having instigated a major split within classicism on whether economics ought to develop toward pure theory or *anschauliche* theory. Ricardo makes the grade as far as his analytical ability goes, but "to him who accepts that economics is and has to be sociology, *Gesellschaftslehre*, Ricardo's method must seem like anatomizing a body alive." Socialism and historicism are grouped together as "evolutionary sciences" whereby the author apparently understands by evolution an objective process within the sphere of "real" history just as Marx did. Generally, Salin likes to make a case for Marx, although not for Marxian economics. It is in tune with the author's endless verbal portraiture, and frequent platitudes when he writes not of the analyst Marx but of the impact of his work, ascribing the reason for this to Marx's ability to "historically" demonstrate the phenomenon of class struggle, exploitation, and the disharmonies of society. When Salin makes analytical attempts, he fails. For instance, in defending the labor theory of value which Salin does on old, worn-out grounds, he is calling on Galiani for support, while, unfortunately, according to the Italian writer it is not labor costs which determines value but rather value which determines labor costs.

As to the aims and method of the historical school, Salin adds nothing to what has been known to generations of students. His major point of criticism is the same as it was back in 1923, namely Schmoller's "detailed . . . historical research." Unjustifiably, he ranks V. Thuenen, whose method was rigidly theoretical, among the historians. One cannot but doubt that the author means what he has been critically remarking about the historians. His book is biased in favor of "organic" terms and against rationalism, "mechanics." His dream is with some theory-connected historicism which "might be emerging in the last quarter of the century." This prophesy expresses what Salin considers the main methodological winning-post of economic science, namely the "theoretical penetration" and "empirical-observational" (*anschauliche-systematische*) structuring of historical data to better comprehend the functioning of the real economic world (*lebendige politische Oekonomie*).

Whoever, in Salin's opinion, has "happily" combined deduction and induction in explaining the economic world is a "predecessor," one who pioneers what future generations will practice, such as M. Weber, Sombart, Spiethoff, Keynes, I. Fisher, F. Knight. On the other hand, M. Weber's attempt to

remove value judgments from economics is bemoaned as "negative success" because it released a rapacious rationality with no room for the "powers of life" (*Lebensmaechte*), Spiethoff is referred to as a shining example that a combination of pure and "historical" theory is possible. Salin does not mention, however, that Spiethoff himself thought these two should not be combined.

A total view of the economic world possible only by marriage of "observational" theory and theoretical analysis, so Salin says, had been prevented by the "barbarism of specialization." In this category he seems to be grouping nearly everybody from the marginalists to the mathematically inclined in economics, the "technical theorists." Salin believes that unifying forces such as technology and the common interest in economic development entail opportunities for "true political economics," i.e., an all-encompassing, historical and theoretical approach to economic problems.

The book in its original version may have been a contribution in the 1920s when the *Methodenstreit*, the struggle for the "correct" approach in economic analysis, was still occupying beyond reason able people who could have invested their time more wisely. Today, the revised book cannot be taken as a piece of literature which makes economic education attractive and improves structure and content of economic science. The volume gives testimony of a learned man who has assimilated much knowledge; however, the value of many of his conclusions cannot be seen by a world he himself does not trust anymore.

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### **Economic History; Economic Development; National Economies**

*Industrial Retardation in Britain, 1880-1914.* By A. L. LEVINE. New York: Basic Books, 1967. Pp. x, 201. \$6.95.

The study of industrial change by economists knows few geographic or temporal limitations. The study of industrial retardation is another matter. Great Britain from roughly 1880 to the first world war presents something of a classic case. It was "a period that witnessed a marked quickening in the pace of technical and organizational change in the manufacturing industries of the major industrial powers. How did British manufacturing industry perform when there were now, indisputably, two other great industrial powers?" (p. ix). The question has commanded considerable attention from economists like Hobson, Marshall and Veblen, as well as journalists, politicians, trade unionists and representative government committees. It remains relevant for those who today would better understand the causes of slow British growth in the recent as well as more distant past.

By industrial retardation Levine means simply the lag of British industries, in terms of technology and organization, behind those of the United States and Germany. Evidence of such a lag is offered in an introductory chapter. Some of it is quantitative and includes data on levels and growth of factor

productivity. Some of it is qualitative and makes the point, among others, that Britain was not in the forefront either as a *de novo* innovator or as an adopter of innovations.

A second section of the volume examines systematically the nature of British weaknesses in technology and organization. Regarding technology, the argument stresses four factors: the relative lag in mechanization; the slower pace of production; a comparative neglect of electrification; and the backward state of the iron and steel industry. Regarding organization, the strategic shortcomings are seen to lie in a proliferation of small-size plants, with insufficient vertical integration and inadequate specialization of labor and limitation of variety. These arguments are not new, but have often been made in the past by diversely situated observers. Levine has usefully systematized and ordered them, along with supporting evidence, in a way that facilitates understanding and evaluation.

Explanation is the task of Part III. This section dominates the book and will, for most readers, hold the greatest interest. In a conscientious assessment of British enterprise and management and of the socio-economic framework in which it functioned, the author comments on the "sheer inertia, excessive confidence, and complacency" of industrialists, on their "abysmal lack of interest . . . in science and research" (p. 69), on social immobility and a "too highly developed class consciousness up and down the social scale" (p. 72). He cites the disdain of industrial opportunities and careers by the educated upper classes, accompanied by barriers to such opportunities facing the lower classes, and he scores the school and university curricula for neglecting technical and science training and other forms of education that might contribute to professional management.

The trade unions come off a bit easier. It is almost natural that they should, for unlike their employer opposites, they are not expected to play the role of advance scouts and initiators in industrial change and growth. Yet one detects in Levine's approach to labor a predisposition, not apparent in his earlier discussion of management, to grant it the benefit of doubts. Of the allegation that unions restricted output, he asks whether the evidence was "incontrovertible" (p. 85), and of the contention that they retarded technical advance, he asks whether the case is "entirely conclusive" (p. 96). However, balance is redressed somewhat in his summing up on labor's role, wherein he affirms some justification "for the belief that Britain's working classes formed (and continue to form) the most conservative stratum of an essentially conservative society" (p. 97).

Levine's framework is not tightly theoretical, nor does his argument move from narrow premises to certain conclusions via any delimited, sharply defined hypothesis. Rather his approach, which proceeds by identifying factors of possible relevance and bringing to bear on them both quantitative and qualitative evidence, is essentially a pragmatic blend of theory and history. In view of the breadth and complexity of the phenomenon under study, it is doubtless a suitable approach—one that permits sweep, an appropriate degree of analytic flexibility, and persuasive if not always irrefutable judgments.

A useful summary chapter not only records the author's own views on Brit-



ish retardation, but through these views probably renders a fair account of such consensus as may currently exist among observers of the problem. Overall, the volume provides a valuable survey and summing up on a long-standing, important, much debated and vexing issue. The conclusions which, after all the evidence, Levine settles upon, are not encouraging with respect to Britain's capacity for a markedly better industrial performance in the years to come.

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*An Economic History of Western Europe, 1945-1964.* By M. M. POSTAN.  
London: Methuen & Co.; New York: Barnes & Noble, distrib., 1967.  
Pp. 382. \$7.50; paper, \$4.00.

Few economic phenomena have been so intensively analyzed as the surge of economic growth in the industrial, more-or-less capitalist, countries in the period since World War II. Leaving aside the perennial special case of Japan, the noted contrast has been that between western Europe's recent performance and its closest analogs in time and space: the postwar United States and Europe itself before 1939. Now, Professor Postan gives us a historian's survey designed to provide the perspective that nearness, direct involvement, and the very flood of commentary may have obscured. The present book is roughly contemporaneous with a new generation of more technical and narrowly focused analyses of the European growth experience, and Postan acknowledges familiarity with the recent contributions of such writers as Maddison, Denison, Shonfield, and Kindleberger, although the vagaries of the publishing process make it difficult for him to use their findings systematically.

The preface refers to the book as a semipopular treatise. Its first part, entitled "Growth," begins with a summary of the record of the past two decades, usefully drawing on many countries while emphasizing the uniformities in Europe's experience rather than this miracle or that crisis. This is followed by a critique of some economic causes that have been put forward to explain rapid growth. Here are to be found those more technical passages that justify the qualifying "semi" in the author's own presentation of the book. The second part describes "The Changing Shape" of agriculture, of industrial ownership and management, and of the ways people live and work.

Postan's book contains many good things, a reflection of the breadth of his experience with economies and economics. He combines a constant awareness of the long term with a concrete and "microeconomic" concern for technology and managerial decision-making. He draws both on the factor-price approach of Western production-function analysis and on Marxist class views, and yet retains a feeling for labor and capital as provided by and for people. There are good summaries of the literature stressing the positive role of planning and international trade, and a more original view of the genesis of "Growthmanship" as a conscious policy. The section dealing with social changes in the labor force, based on the declining importance of craft skills and the increasing role of general and vocational education, is stimulating. Finally, one may mention the analysis of change in the control of industry and commerce,

where Postan shows that the old capitalist class has produced technocrats as often as it has given way to outside professionals.

The economic analysis of the reasons for rapid and sustained growth is a good deal less successful. It is not merely that the arguments regarding the role of relative factor prices in investment and innovation, say, are inconclusive. This is to a large extent inevitable in view of the limited data available. But Postan does not, one feels, give such arguments a fair trial or use them to throw a sharper, if unbalanced, light on the scene. He believes that innovation, and the entrepreneurial dynamism that promotes it, are the key explanatory variables, and approaches other explanations largely with a view to clearing the field so as to leave his champion alone and unchallenged in the lists. It is no very hard task for him to cast doubts on the validity of alternative hypotheses, especially taken one by one.

Moreover, the edge of the economic argument is blunted by the attempt to play down the lag in the United Kingdom's economic performance, useful as this emphasis may be in balancing certain overdrawn contrasts between Britain and the major Continental countries. However, accidental or exogenous causes are given unfortunately large weight in accounting for the case of Britain, especially in the crucial area of export performance. Nor is the evidence always presented with entire objectivity. On pages 72-75, Postan argues that exports did not grow so slowly after all, and that their composition shifted in a progressive direction. But the key growth rate for British exports of 1.8 per cent per year (1948-1962) is not mentioned until page 91. To be sure, the trend in exports was much better than in the interwar years, but Britain participated fully in the changes that promoted increased postwar trade, especially in capital goods and other highly technical manufactures. Rapid growth in the trade of other industrial nations should have been reflected in demand for British goods. Trade begets trade, and Britain's market opportunities were of a different order of magnitude from those of the dark thirties. It follows that a harsher verdict must be given regarding Britain's ability to improve productivity and, especially, to reallocate resources.

Despite these difficulties, which may put off economists who naturally look to the most technical passages for the substance of an argument, Postan has produced a readable, balanced, and informative book that will be useful to students, beginners and professionals alike, of postwar Europe and of change in industrial societies.

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*Export Instability and Economic Development.* By ALASDAIR I. MACBEAN. Cambridge: Harvard University Press; London: Allen and Unwin, 1966. Pp. 367. \$6.95.

This is an important book because it attempts an empirical verification of widely held views on the detrimental effects of fluctuations in exports of developing countries on their economic performance. The book falls broadly into two parts. The first is essentially statistical and analytical while the second is concerned with alternative stabilization policies. The author's

attitude toward policy, particularly to possible international commodity stabilization schemes, is heavily influenced by the generally negative results of his statistical analysis which indicated, apparently, that export fluctuations have no significant adverse effects on economic development. The statistical analysis, which thus constitutes the core of the book is, however, generally not convincing.

The statistical and analytical part is divided into a discussion of the short-term consequences of export instability for the economies of developing countries (Ch. 3); the longer-run effects of export instability on the rate of growth in GNP (Ch. 4); and a series of case studies of fluctuations in exports, and in the internal economies, of a number of developing countries.

The analysis of the short-term consequences of export instability focuses on the relationship of such instability with fluctuations in imports, in domestic fixed capital formation, in domestic prices and in monetary reserves. The author uses both cross-country comparisons and time series for individual countries but neither approach is used convincingly while, at crucial points in the argument, the statistical evidence adduced appears to be in direct contradiction with the author's conclusions.

The discussion of the relationship between fluctuations in export earnings and in gross national product is based largely on annual statistics for eleven developing countries, generally covering the period 1950-60, though the period is considerably shorter than this for some countries. After making a crude adjustment for trend in both export and income series, the author analyzes the relationship between annual changes in the two series in two ways. The first consists of counting the number of years in which the changes were in the same direction. With no time lag, there were 61 cases out of 99 in which exports changed in the same direction as GNP while, with a one-year lag, the score was only 45 out of 89. The second test was to relate the absolute annual change in GNP to the absolute change in exports over periods in which export earnings suffered a sharp decline. The author finds that, apart from two cases, the ratio of income to export change falls within the range of 0.26 to 2.62, with five cases below unity and five slightly above. His conclusion is that, in these highly trade-oriented countries, fluctuations in GNP appear to be quite heavily dampened (p. 68). Later he states, even more categorically, that in "most cases fluctuations in income do not appear to be at all closely related to fluctuations in export earnings. . . . This lack of relationship cannot be explained simply by the relative quantitative importance of exports in their economies for, even with countries chosen for high ratios of exports to gross national product, no correlation can be found" (p. 339).

Neither of the author's tests is, however, statistically meaningful; the first because it implicitly assumes that all changes in the same, or opposite, direction are of equal importance; the second because it relates generally to only one or two years in which random factors can considerably distort the underlying relationship. It is, indeed, surprising that Professor MacBean, who uses single equation regressions at many other points, has failed to use such regressions to test one of his central conclusions. Had he

done so, he would have found that, despite his explicit assertions to the contrary, a close connection does, in fact, exist between fluctuations in exports and in GNP in about half of his sample of developing countries. Using his own trend-corrected series, the results for 5 of his 11 countries are as follows (using a linear equation  $Y = a + bX$ , where  $Y$  represents fluctuations in GNP and  $X$  fluctuations in exports):

	$a$	$b$	$R^2$
Burma	0.03	1.16 (0.02)	0.90
Ceylon	4.34	1.41 (0.09)	0.74
Congo (L.)	0.36	1.01 (0.07)	0.67
Rhodesia and Nyasaland	-0.21	0.86 (0.07)	0.58
Cuba	25.2	1.75 (0.40)	0.56

The relationship is less close for the other countries; on inspection it appears that this is due, in most cases, to special circumstances in one or two years, which obscure the underlying relationship. For one country, Honduras, the time lag between fluctuations in exports and in income appears to have lengthened over the period covered by MacBean's analysis; if allowance is made for this, the association is reasonably close.

It is, admittedly, difficult to make any valid generalization from such limited data but, so far as it goes, the data presented in this book would seem to support the view that short-term variations in national income in many, probably the majority, of developing countries are associated with variations in those countries' export proceeds.

The discussion of the relationship between fluctuations in exports and in investment is largely based on data, for the decade 1948-58, for ten Latin American countries. Unfortunately, the data for the two series are taken from different sources, the investment data being in constant prices in domestic currencies, while exports are valued at current dollar prices. This valuation discrepancy could be important when the relationship studied is a rather difficult one to establish. In the present case the author succeeds in establishing "a fairly consistent relationship" between export fluctuations and fluctuations in imports of capital goods; and also "a statistically significant relationship between [fluctuations in] capital goods imports and investment" (p. 72). One would have thought that these two relationships taken together would imply a third, namely between fluctuations in exports and in investment. But the author assures us (p. 73) that "rank correlations for each country . . . reveal very little consistent relationship between export fluctuations and fixed investment." There would seem to be some inconsistency in analysis here.

In the course of his exposition, MacBean throws some useful sidelights on the relation between fluctuations in exports and fluctuations in internal prices and in the monetary reserves of developing countries. He shows that changes in reserves have generally been compensatory, though the amount of the changes in reserves has seldom corresponded closely to the changes in export proceeds. He does, however, suggest (p. 81) that "the typical under-developed country holds rather higher reserves, around 20 per cent more than the typical developed country." This statement is based on

comparing the ratio of reserves to imports in the years 1956-57. However, a more meaningful indicator of the adequacy of reserves would be their ratio to the trade balance, or to the average fluctuation in the trade balance. Taking 25 developing countries and 14 developed countries for which the relevant data are published in *International Financial Statistics*, their average reserve ratios for the period 1960-66 compare as follows:

	Ratio of Reserves (1960-66) to:	
	Average Trade Balance	Average Annual Change in Trade Balance
Developing countries:		
Arithmetic mean	6.7	7.6
Median	2.2	2.2
Developed countries:		
Arithmetic mean	12.7	20.8
Median	3.3	12.9

On either of these criteria, the level of reserves held by developing countries is far less adequate than are those held by developed countries.

The remainder of the author's discussion on the short-term consequences of export instability consists of a series of ingenious explanations of why GNP should not be sensitive to fluctuations in exports of underdeveloped countries. Some of these explanations, such as the high marginal propensity to import and the stabilizing expenditures of expatriate firms, are clearly of importance in the economies of certain countries. But the argument lacks conviction since its premise would not seem to have general validity.

The analysis of the relationship between export fluctuation and the rate of economic growth in developing countries in Chapter 4 is conducted entirely on the basis of cross-country regressions (though cross-country comparisons were also used in the discussion of short-term consequences, discussed above, they were essentially subsidiary to the time series analysis). The cross-country regressions showed no significant relationship between the degree of export fluctuation and the rate of growth in domestic fixed capital formation; indeed, the results indicated that, if anything, a positive association appeared to exist. The statistical analysis also revealed a positive relationship between export fluctuation and the average rate of increase in domestic prices, but no significant relationship between export fluctuation and the growth rate of national income. MacBearn concludes that, while for individual developing countries, fluctuations in export earnings may have seriously reduced their ability to achieve high rates of economic growth, for developing countries in general "the evidence indicates that export fluctuation has not been an important obstacle to their economic development" (p. 127).

MacBearn's analysis has, however, a number of important limitations. To begin with purely statistical questions, it is clearly vital to base the

analysis on comparable and correctly articulated series. For many of the countries included in his regressions, however, articulation is not satisfactory (for example, whereas the index of export fluctuation relates to the period 1948-58, the annual rate of growth in fixed capital formation relates to much shorter periods for many countries, often from 1950 or 1951 to 1955, 1956 or 1957). This circumstance alone could seriously affect the regression results.

A second statistical difficulty is created by including in the regressions every possible country for which data can be obtained or estimated. For a few countries, some of the variables appear so abnormal as to raise doubts about their accuracy; alternatively, if they are accurate, they would seem to constitute special cases which could reasonably be excluded. The reason for the positive association found in the regression between export fluctuation and the growth rate of fixed capital formation, for example, would seem to be largely a reflection of the inclusion of Morocco, the only country to show an absolute decline in investment over the period, in spite of only small export fluctuations, and Iraq, with an unusually high growth in investment associated with an above-average degree of export fluctuation.

Another example of how the inclusion of a few special cases affects the regression results is the author's equation for the relation between export fluctuations and the growth rate of GDP. Using data for 21 developing countries, he arrives at the following results (p. 123):

$$\dot{Y} = 3.6 - 0.0082X_e + 0.4278\dot{X} \\ (0.2811) \quad (0.1267)$$

( $R^2=0.4285$ ), where  $\dot{Y}$ =rate of growth of GDP,  $X_e$ =instability of importing power of exports and  $\dot{X}$ =rate of growth of import capacity. This result shows that, for the developing countries included, "little or no relationship exists between short-term instability in their export proceeds and the rate of growth of their national incomes" (p. 124). However, if a few special cases are excluded, and the GDP is related to the growth in fixed investment ( $\dot{I}$ ) rather than in import capacity, the following equation can be calculated for 16 developing countries from MacBean's data:

$$\dot{Y} = 5.6 - 0.353X_e + 0.289\dot{I} \\ (0.042) \quad (0.159)$$

( $R^2=0.785$ ). This result would appear to be a reasonably good explanation of intercountry differences in rates of economic growth. It also strongly suggests that highly unstable exports are likely to be a significant constraint on the rate of economic growth of many developing countries.

Nonetheless, it would be unwise to draw firm conclusions from cross-country comparisons such as these. Their major drawback is their implicit assumption that there is a single, unique, relationship between a given degree of fluctuation in exports and the resultant change in the growth rate of GNP for all countries. Because of differences in economic structures, in the degree of dependence of different economies on the foreign trade sector

particularly for supplies of capital equipment, and in the ways in which they adjust to short-term changes in foreign exchange earnings, the impact of a given fluctuation in export earnings on the long-term growth rate of GNP is likely to vary substantially between different developing countries. For this reason, none of the regressions presented in this part of the book can be accepted as meaningful, and the author's conclusions are equally suspect. It would seem that the only valid approach to the problem would be to analyze the effect of export fluctuations on the economic growth of each developing country separately.

MacBean goes some way in this direction in his analysis of economic developments in five countries—Uganda, Tanganyika, Puerto Rico, Chile, and Pakistan—which together constitute a well-chosen sample, exhibiting a variety of relationships between the export sector and the domestic economy. This is, perhaps, the most interesting portion of the book and the author uses the available data skillfully and with insight. He finds, not surprisingly, a variety of degrees of dependence of the domestic economy on the export sector. For Uganda, there is evidence of a systematic relationship between capital goods imports and domestic capital formation and the previous year's export earnings, but the connection is much less clear for the other sample countries. For Chile, indeed, fluctuations in export value may be irrelevant to variations in domestic income; what matters is rather the "value returned" by the expatriate copper companies to the Chilean economy.

Useful though these country studies are, they do not constitute a systematic analysis of the problem at hand. A major limitation, in the case of the less-developed countries in the sample, is the lack of reliable, relevant and comparable statistical series. This introduces a note of uncertainty at many places in the argument. For such countries, a definitive analysis of the effects of fluctuations in exports will have to await improvements in basic statistical data. For other developing countries, the most promising approach would probably be to start with a computable model of the working of the economy, and then to simulate the effects of introducing a series of random shocks (or a pattern of shocks based on past experience) in the export sector. Though MacBean's work cannot be regarded as definitive—indeed, at several crucial points his generalizations do not appear valid—it has exposed an important problem in applied economics and has laid the basis for a more systematic approach in the future.

A. MAIZELS

*Geneva, Switzerland*

*International Development 1966*. Edited by H. W. SINGER, NICHOLAS DE KUN AND ABBAS ORDOOBADI. Dobbs Ferry: Oceana Publications, 1967. Pp. vii, 341. \$10.00.

The Society for International Development is, according to its own characterization, an assemblage of persons mainly engaged in or associated with programs of international development. Its main purpose is to stimulate the ex-

change of ideas, facts, and experience in its special field of interest. Like most such societies, it holds annual meetings with speeches, panel discussions, and papers devoted to some of the currently prominent or controversial topics of development.

With its sixth such meeting in 1964, the Society apparently decided that the substance of these sessions was worth preserving and compiled a volume of proceedings.<sup>1</sup> This was followed by a sequel in 1965<sup>2</sup> and the latest volume which is here under review. The size of these volumes has more than doubled between the 1964 and 1966 compendia which causes one to wonder about the future growth curve. As with most cases of overrapid growth, however, there has been some obvious misallocation of resources resulting from an overly protective editorial policy. Presumably if healthy growth is to occur in the future, there will be some shaking out of the weaker parts of the system.

Altogether there are 54 papers in the latest volume. Some of the main topics dealt with are: how to change agricultural technology; the relations between industrialization and agricultural development; trade patterns and the role of import substitution; changing aid patterns and the nature of absorptive capacity; institutional reports on the regional development banks; and a discussion of the so-called "brain drain." By and large these selections represent an effort to transmit some of the recent thinking—especially of the academicians—to the practitioners, and some of the lessons of experience of the "old hands" to the new recruits. There is also an element of the "pep rally" to raise the flagging spirits of those involved in the "development business."

One of the worst features of the volume is that the editors have excluded practically all footnotes or citations of references which makes it exceedingly difficult to ascertain how these individual papers relate to the existing literature or if they are available in greater detail elsewhere. While this is not a problem for some of the more personalized or reportorial papers, it is a serious disadvantage for the more theoretical papers. This editorial policy is most distressing in connection with two of the best papers in the book—one by John H. Power on import substitution and another by Vernon W. Ruttan on industrialization and agricultural development—both of which review and evaluate the literature without ever citing the sources of the writings. Anyone wishing to explore these writings on his own would have to spend much time in retracing the author's steps, unless he could find a more professional version of the same paper in a standard journal.

The Power paper explores the dangers of industrialization strategies biased toward import substitution. Ruttan compares the "stages of growth" theories of development with the "dualistic economy" theories and concludes that while both "focus attention on the critical role of agriculture in the development process," neither offers policy guidance on how to raise agricultural productivity. A related paper by John Mellor argues that the most important factor for raising agricultural productivity is the institutional arrangements

<sup>1</sup> Theodore Geiger and Leo Solomon, ed., *Motivations and Methods in Development and Foreign Aid*. Washington 1964.

<sup>2</sup> Stephan H. Rubock and Leo M. Solomon, ed., *International Development 1965*. Dobbs Ferry 1966.



for supplying those inputs which embody new technology, and that planning for agricultural development should concentrate on the design of such institutions.

Several papers focus on the trade gaps of the developing countries and policies to overcome them. (An interesting omission is any serious concern over the domestic savings gap.) Raul Prebisch presents his oft-expressed arguments for a reorganization of world trade policies and Lal Jayawardene, a member of the UNCTAD staff, makes the case for preferential treatment of manufactured exports from the developing countries.

There is no underlying theme to this volume and the numerous individual pieces defy separate evaluation. Perhaps the most meaningful commentary is in terms of the utility of the overall collection. I doubt that it will find much use as supplementary reading for courses on development because of its uneven coverage and because most of the more comprehensive papers are likely to be presented elsewhere in fuller and more professional form. Similarly, I doubt that anyone other than the editors and a few reviewers will read the book from cover to cover, and I would not suggest that such a reading is rewarding. Perhaps some individuals in remote parts of the world who do not have access to recent journals and texts may gain some insights into recent thinking on the topics covered in the book, but I question whether this justifies the effort that went into its preparation. If such volumes are to be produced in the future, their usefulness would be enhanced by some indication of references especially where a fuller treatment of the given topic may be found.

DAVID C. COLE

*Harvard University*

*The Economics of Poverty.* By THOMAS BALOGH. New York: Macmillan, 1966; London: Weidenfeld and Nicholson, 1967. Pp. xvii, 374. \$7.95.

The persistent refrain throughout this selection from Balogh's work during the period 1955 to 1966 is that the theory and institutions of the North Atlantic community are not easily transferable to the less developed areas of the world. Reading it, one sees the author as the boy at the dike, trying desperately to stem the tide of ignorance. The analogy is particularly apt when Balogh's references to the literature of development are directed to such authors as Schultz and Tinbergen.

Originally published in professional journals or circulated as memoranda, conference papers, and reports, most of the 20 articles in the volume deal with particular problems of development in Asia, sub-Saharan Africa, Latin America, and the Mediterranean. However, several short pieces discuss the relevance of the market to developing economies, and several others are devoted to the role of agriculture, education, and trade.

Repeatedly, Balogh points out that the extreme heterogeneity of most underdeveloped territories makes them poor hosts to policies built upon the assumption of homogeneity and linearity. The labor forces, managerial elites, and pervasive cultures of the advanced nations, even in their early stages of development, were far more homogeneous than Africa, Asia, or Latin America

today, or even tomorrow. Commenting on the Tinbergen model for education, given at an OECD Conference in 1962, he says. "A bit of common sense in asking the relevant questions before one sets out to build up a model, and a knowledge of the particular historical or sociological factors, surely is necessary" (p. 88).

For example, increasing the input of conventional literary education probably deters growth. As the West African experience has shown, this produces school-leavers who are alienated from the only sector capable of absorbing them, agriculture. Thus alienated and lacking marketable skills, they flock to the cities to swell the tide of unemployment and to create a potentially explosive, detribalized proletariat. Just because the United States data show a good statistical fit between economic growth and the investment in human capital, one cannot assume that the policy is transferable, for instance, to Nigeria. And it is not only a question of what kind of education. In an economy which lacks a demand for skilled labor, learning to run a wood lathe in a technical school is no greater advantage than learning Shakespeare.

Balogh attributes the breach between "development economics" and the received doctrines of the more traditional vein to a failure to recognize the nature of the assumptions that the two groups utilize. The more involved the development economist becomes with the problems of particular countries, the greater his concern with heterogeneity, while in advanced economies, the production functions are becoming increasingly linear and homogeneous. The breach will widen, he suggests, just as the differential in income widens between the two types of economies. Again using education as the example, the supply of school teachers in the United States might readily be increased through a subsidy to teacher education or a tax benefit to teachers. But in Africa, such a policy might not work because the education that would enable an individual to teach might also open government or commercial opportunities to him. The failure to place economic theory and policy within the framework of a particular country's social and political practices is not unique to any one area or one group. Balogh discusses the problem in relation to India (p. 367), Nigeria (p. 90), and Jamaica (p. 316).

The British and American failure to develop new theories and policy to aid the less developed nations in escaping from poverty is discussed in a brief introduction written in 1964, before Balogh became a member of the Labor Government Establishment. He expresses discouragement that this inadequacy should continue to push the underdeveloped nations "to other sources of knowledge and inspiration." "The non-Communist world," he wrote in 1958, "must realize the terrible urgency of rapid development away from peasant production and towards the establishment of modern industry and agriculture, if convulsions, and a possible catastrophe, are to be avoided" (p. 55).

The large number of spasms in the world today suggest that we have not realized that urgency, or perhaps have simply not met its challenge, and Balogh's criticisms of economic theory and policy go a long way toward explaining why!

JOHN P. HENDERSON

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*Latin America: Problems and Perspectives of Economic Development, 1963-1964.* By the Department of Economic Affairs, Pan American Union. Baltimore: The Johns Hopkins Press, 1966. Pp. 242. \$6.50.

This book contains an effort on the part of the Pan American Union to assume the reporting function which for many years has been performed by the United Nations' Economic Commission for Latin America in its annual *Economic Survey of Latin America*. As in the case with the ECLA series, the book's purpose is to identify the constraints on development in each country and the region generally, and to report on progress (or lack thereof) in coping with the various internal and external difficulties confronted during the period considered. In addition, in the volume under review a special effort is made to formulate an appraisal of the Alliance for Progress since its inception through 1964.

There are four rather longish chapters. The first, entitled "Current Status and Immediate Outlook for Latin American Development," contains a review of estimated growth rates and perceived development constraints by country for the period 1960-1964, with projections for 1965-1966. External resource availability is identified as the principal constraint operating throughout the region, and a detailed analysis is presented of foreign exchange receipts on both current and capital account and on both a gross and net basis. The second chapter, entitled "Export Problems, Prospects, and Efforts Toward Regional Integration," is devoted primarily to discussion of problems in the markets for traditional commodity exports and of efforts to achieve greater export diversification. The third and fourth chapters are entitled, respectively, "Problems of External Financing" and "Problems of Domestic Efforts," and together constitute the main substance of the book. Throughout the text is interspersed a large amount of statistical information, there being 69 tables in all.

In Chapter 3, after a detailed review of the inflow of official external funds (by source, and in terms of both new commitments and actual disbursements), it is concluded that the problem confronting Latin America "is not so much one of shortage of aid in general as one of specified type" (p. 157).

Savings which the private sector . . . [of the developed world] . . . is willing to invest . . . directly, or which official agencies can capture through taxation or loans for the purpose of relending to . . . Latin America, are more than sufficient to attend to all development projects, *provided* [emphasis added] they meet all the following requirements: they must yield a return comparable to ventures involving similar risks at home, they must be amortizable over relatively short periods and must not present any . . . exchange risks. . . . A grave problem exists with regard to financing projects and programs which do not meet one or more of the specifications. . . . Giving more help at considerably more flexible terms than presently granted to finance programs and projects which do not yield direct returns is essential to assure the success of the Alliance (p. 157).

The case for softer terms on official loans is, of course, buttressed by reference to the external debt problem of Latin America. But, interestingly enough, the authors go beyond calling for greater magnanimity on the part of official

foreign-lending institutions—by urging Latin American governments to make greater efforts to avail themselves of the potentially larger inflow of private investment from abroad. After noting that “the confidence of foreign investors arises . . . from the attitudes of the governments toward foreign capital” and that “when this attitude is properly expressed in an articulate, coherent policy that can be expected to persist in the future, foreign capital finds the framework it requires to plan and develop its activities systematically” (pp. 169-70), the book goes on to suggest “a number of measures . . . for promoting a favorable climate for foreign investment in Latin America, particularly in the manufacturing sector” (p. 173). The suggestions include: establishment of industrialization priorities which make sense to potential investors in the context of a country’s overall development program; reasonable provision for remittance of profits; and, more generally, greater emphasis on promotion of foreign investment by individual countries and the region as a whole.

With respect to the “domestic efforts” required on the part of the Latin American countries, the usual analyses are offered—namely, that public sector savings must be increased by tax reforms and other measures; that public administration must be improved for more effective development planning and financial control; and, that additional emphasis must be given to achievement of greater agricultural productivity, especially by means of land tenure reform.

While a commendable effort has obviously been made to construct a balanced appraisal of the available evidence, the book is somehow less readable as a consequence. For those who (like myself) prefer to be challenged by the often-loaded ECLA presentations it is indeed fortunate that publication of the *Economic Survey* is not (as was once planned) to be terminated in favor of future Pan American Union volumes in this series.

DWIGHT S. BROTHERS

*Harvard University*

*es*

*A Village Economy—Land and People of Huecorio.* By MICHAEL BELSHAW. New York and London: Columbia University Press, 1967. Pp. xxiv, 421. \$10.00.

After spending over two decades in a frustrated search for simple solutions to the problem of economic development, the profession is returning to first principles. There is growing recognition of a need for broad and detailed historical and institutional material on specific economic systems as preconditions for the construction of diagnostic and prescriptive models of resource allocation, income determination, and growth. As with the classificatory schemes based on myriad observations which biologists employ to determine what has *not* as well as what has happened in a specific ecological setting, economic taxonomies must be built up from painstakingly collected factual detail to be able to reveal what ought to be occurring in a given economic environment. Otherwise the economic models will be powerless to isolate essential elements of growth which are missing in a particular system much less explain their absence. The development economist on recognizing the need for a maximum of factual detail and the interplay of social, political, and even psychological fac-

tors in economic behavior is rapidly becoming a human ecologist especially as he begins to analyze peasant communities.

Small wonder that the mainstream of development economics has until now avoided peasant communities, leaving this fascinating terrain to the economic anthropologist and sociologist. In this vein it is good to discover a book such as Belshaw's which it is hoped will set a trend. The fact that the author is in a new area for economists *per se* helps to explain (and perhaps excuse) the analytical weaknesses of the present volume. Though explorers often get lost and occasionally die in the wilderness, they point the way ahead. Although Belshaw appears at times to have wandered without map or compass, the pages of his travel record are filled with fascinating detail that will provide indispensable reference points for future social scientists.

The region selected for study is a small village on the shore of Lake Pátzcuaro in the Tarascan highlands of the state of Michoacán in Mexico. Apart from several independent visits by the author, the majority of research was conducted during the summer of 1962 by a team of his students using questionnaires which he had prepared earlier. Meso-American peasant communities and particularly those in the south-central region of Mexico have been subjected to frequent and penetrating analysis by anthropologists giving rise to works by, among others, Robert Redfield, George M. Foster, Ralph L. Beals, and Oscar Lewis. As early as 1952 Howard Cline cites 24 major studies of modern Mexican communities including three in the state of Michoacán alone.<sup>1</sup> Although Belshaw makes occasional references to factual material from other community studies in Mexico, he seems to have written largely outside of the context of the rich anthropological literature on the subject.

Admittedly, despite its high quality, little of the anthropological research (with the possible exception of the works of Sol Tax and George M. Foster) provides much material on those aspects of activity relevant to the problems of development, including the economic implications of acculturation or its lack. Since the author deals specifically with these questions it is unfortunate that he does not publish the questionnaires or interview designs used in his research. Nor does he provide a theoretical framework for the study except to organize the chapters in the form of a production function following the pattern of traditional economic development texts dealing with land, agricultural technology, labor, capital, and entrepreneurship in succession. Problems of the political and social structure of Huecorio, characteristics and rates of growth of its population, living levels, and rural welfare policies are considered in detail though largely in isolation with little or no attempt to integrate the analysis.

The selection of Huecorio among the thousands of villages of Mexico was by no means random, since the author admits "The community would have to be open and not hostile to outsiders who would not have time for the usual 'softening up' and familiarization; and it would have to accept the intrusion of a group of people rather than the quiet insinuation of one person working by himself. Huecorio proved a happy choice" (p. xiv). Because the town is

<sup>1</sup> Howard Cline, "Review Article: Mexican Community Studies," *Hispanic Am. Hist. Rev.*, 1952, 32, 212-42.

adjacent to a tourist center (Pátzcuaro), close to a trunk highway which is a major route of migrant farm workers moving north and west, is located on a rail line, was an important center of civilization before the Conquest, is near a UNESCO-sponsored center for rural education (CREFAL), and has received technical assistance from the FAO, the federal government, and Montana State College and has received indirect benefits from a major river basin development project (Tepalcatepec) immediately to the south, it cannot be called a typical Mexican community. Huecorio is high, cold, and somewhat inhospitable climatically and, although its population has doubled in the past 30 years (below the national rate), the agricultural labor force has risen only 28 per cent since 1922. Productivity per hectare has apparently declined, except where fertilizers have been applied, while the amount of land in use has risen slightly. Yet because it is located in a backward region of one of the most rapidly developing Latin American countries with its people engaged in a continuing compromise between subsistence and commercial cultivation of small plots of land, Huecorio is ideally situated for a study of economic ecology.

Nevertheless the best sections of the book deal with the facts of rural technology at the subsistence level, the importance of the steel plow (and advantages of imported over domestically produced plows), the relative receptivity to new techniques, frustrations of rural extension workers, attitudes of individual farmers to change (described in detail), and comments of those who, after leaving the village as *braceros*, chose to return. The author's documentation of farmers' preferences for income security as a reason for planting less productive subsistence crops (maize and beans) rather than cash crops is convincing and makes an important contribution to the literature on agricultural development. His appraisal of the minifundia system produced by the agrarian reform is complicated by confusions between productivity and employment considerations. In view of low yields in both subsistence and commercial agriculture in Huecorio plus large net emigration from the village and movement of the local labor force into other more productive activities, his arguments for maximization of the man-land ratio through the maintenance of small holdings are unconvincing. Indeed his views of the possibilities of agriculture in Huecorio are almost fatalistic.

The study indicates that despite 20 or more years since agrarian reform and repeated contacts with forces of modernization (improved communications, roads, electricity, rural extension, hybrids, increasing urban demand for cash crops of the region, and education) present living levels in the community are still extremely low. Although this is attributed to a limited amount of land which is itself of low quality plus population pressure and the lack of public investment in the development of the *municipio* itself, the study suffers from a lack of historical perspective or a sufficiently ecological approach.<sup>2</sup> Perhaps the solution to the problem of Huecorio is emigration rather than expenditures on infrastructure, technical assistance, and subsidized loans. One can-

<sup>2</sup> An interesting but controversial presentation of an ecological approach to community development is offered by Richard N. Adams, "The Community in Latin America: A Changing Myth," *Centennial Rev. Arts and Sci.*, 1962, 6, 409-34.

not blame the author for the failure of the profession to provide an analytical framework in which to integrate the important and interesting descriptive detail of his study. One would have hoped, however, that he might have traced a rough map for future scholars. Nevertheless he has provided a wealth of source material which cannot be ignored by any student of rural development. The author and publisher must be commended on a well-written and impressively bound volume which has enriched the literature.

CLARK W. REYNOLDS

*Stanford University*

### Statistical Methods; Econometrics; Social Accounting

*Essays in Mathematical Economics—in Honor of Oskar Morgenstern.* Edited by MARTIN SHUBIK. Princeton: Princeton University Press, 1967. Pp. xx, 475. \$12.50.

First of all, it should be pointed out that, in spite of the title of this collection, not all the essays are in "mathematical economics" even in the broadest sense. Whitin's discussion of the irrelevance to actual management decisions of the economist's obsession with the determination of optimum factor proportions ("The Role of Economics in Management Science") is not, nor are the papers by Koo on comparative advantage ("Competition of American and Japanese Textiles in the World Market") or Marcus ("Moderating Economic Fluctuations in the Underdeveloped Areas"). It would be a pity if these contributions were buried simply because those who may be most interested in them would hesitate to open covers bearing the word "mathematical," while those primarily interested in mathematical economics passed them by. The remaining essays in the volume do fit the title if we interpret it quite broadly, but the true nature of the collection is, of course, described by the subtitle, "In Honor of Oskar Morgenstern."

Morgenstern's place as one of the immortals of economics is derived from his collaboration with von Neumann. In spite of his many publications, his next most important contribution to economics has been through his interest in, and encouragement of, the work of others. This collection is representative of the people and the topics that bear the mark of this encouragement.

As is fitting, the first and largest group of contributions is in game theory. They represent very well the current relationship of game theory to economics. The theory of games did not have the impact on economics that Morgenstern originally anticipated. It was the first major influence in the moulding of the "new" mathematical economics. However, its younger spiritual cousins, linear programming, activity analysis, and generalized optimizing theory which, like game theory itself, broke with the smooth regular world of neoclassical mathematical economics, proved more directly applicable to a wider range of problems in economic analysis than the theory of games did. Game theory was, and remains, the obviously appropriate tool for the analysis of imperfectly competitive equilibrium. Even now, this analysis has not been completed, but progress is steady (if slow). The first six contributions to the

volume are concerned either with the problem of imperfect competition or with the development of game theory itself in the direction required (multi-person games) for analysis of the problem.

A useful discussion of the general approach to the problem is given by Shapley and Shubik ("Concepts and Theories of Pure Competition"), although one suspects this essay was one of the earliest written for the collection. A particularly good paper in this group is Aumann's ("A Survey of Cooperative Games Without Side Payments"), and this carries the most up-to-date bibliography. The essays by Kuhn ("On Games of Fair Division"), Davis and Maschler ("Existence of Stable Payoff Configurations for Cooperative Games"), Peleg ("Existence Theorem for the Bargaining Set  $M_1^{(1)}$ ") and Shapley ("On Solutions that Exclude One or More Players") are more technical and more limited.

Related in spirit to game theory are two contributions which have been fitted into other groupings, one by Stern on oligopoly ("Some Notes on Oligopoly Theory and Experiments", grouped with the Whitin essay already mentioned under "Management Science"), and the other by Mayberry ("Alternate Prior Distributions in Statistical Decision Theory").

It is interesting to turn from the first grouping in the volume to the last. These five essays under the heading of "Econometrics," comprise two on index number problems and three on spectral analysis. Although the Princeton work on spectral analysis of economic time series represents one of the most recent projects to receive Morgenstern's support, his interest in time series goes very far back. His first published work was in business cycles (1927), and some of Wald's early work on time series analysis was to solve problems brought to the fore by Morgenstern. Incidentally, since we have harked back to Morgenstern's Vienna period, a valuable contribution to the volume is the English version of Menger's paper on the St. Petersburg paradox ("The Role of Uncertainty in Economics") which was originally circulated in the 1920s and published (in German) in 1934.

Of the spectral analysis papers, those by Granger ("New Techniques for Analyzing Economic Time Series and Their Place in Econometrics") and by Hatanaka and Suzuki ("A Theory of the Pseudospectrum and Its Application to Nonstationary Dynamic Economic Models") are theoretical, while that by Godfrey and Karreman ("A Spectrum Analysis of Seasonal Adjustment") compares the application of several methods to artificially generated time series containing a seasonal. In the two index number papers included in the same grouping, Afriat ("The Cost of Living Index") is searching for a cost of living index satisfying consistency tests. Mizutani ("New Formulas for Making Price and Quantity Index Numbers") for an "ideal" index in the manner of Irving Fisher.

The remaining essays are widely dispersed in topics and rather loosely collected under various headings, which should not be taken too seriously. Borch's essay ("The Economics of Uncertainty") is more decision theory than economic theory, and Orr's ("Capital Flexibility and Long Run Cost Under Stationary Uncertainty") as much economic theory as decision theory. Noble turns input-output into output-input ("A Property and Use of Output Coeffi-



clients of a Leontief Model”), Thompson discusses a problem in discrete programming (“Some Approaches to the Solution of Large-Scale Combinatorial Problems”), and Tornquist gives another variation of the formal equivalence of minimaxing and optimal programming (“Minimaxing and Optimal Programming”). There is an application of Bayesian methods (Miyasawa, “A Bayesian Approach to Team Decision Problems”) and a discussion of subjective probability (Pfanzel, “Subjective Probability Derived from the Morgenstern-von Neumann Utility Concept”), a note on a kind of utility by learning (Peston, “Changing Utility Functions”), one of Baumol’s minor pieces (“The Ricardo Effect in the Point Input-Output Case”), and a requisition-smoothing algorithm by Harlan Mills (“Smoothing in Inventory Processes”).

Is there significance in the fact that one of Morgenstern’s special interests is notably unrepresented, namely the line of thought of his *On the Accuracy of Economic Observations*? Perhaps this subject is too uncomfortable.

Any collection of essays from a variety of authors suffers certain disadvantages. A conference volume has, at least, unity of subject, while *Festschrift* has not even this. Thus the potential reader of a volume such as the present one has little guidance as to whether its contents will interest him. A desire to honor a great teacher or colleague does not always run to a willingness to publish one’s latest, or more important, work in the volume. As *Festschriften* go, this one is good enough.

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*Matrix Methods in Economics.* By CLOPPER ALMON, JR. Reading, Mass.: Addison-Wesley, 1967. Pp. 164. \$6.95.

Professor Almon wrote this book because he felt there was a gap between standard introductions to mathematics and statistics, and the conventional texts on econometrics and mathematical economics. There was, in brief, no unified treatment of “matrix inversion, multiple regression, the analysis of variance and covariance, Lagrangian multipliers, linear and nonlinear programming, and the characteristic values of matrices.” He points out that a quantitative economist must have a thorough understanding of these topics before proceeding to the advanced techniques regularly employed by econometricians. In addition, he feels that a quantitative economist should be familiar with a machine language, and his choice for this is FORTRAN. All of the topics mentioned are covered by Almon in this short and tightly written book. While most sections make use of matrices in one way or another this is certainly not a conventional introduction to matrix algebra.

The formal treatment of matrix algebra is limited to the pages of Chapter 1, and a tremendous amount of information is compressed into this limited space. The method of matrix inversion which Almon favors is that of Gauss-Jordan elimination with its pivot operation. In the second chapter the pivotal process is used for least-squares computations, and with a slight addition it becomes the basis of the simplex method of linear programming in Chapter 4. In between, in Chapter 3, Almon presents what is undoubtedly the most compact treatment of FORTRAN programming to appear in print. The remaining

three chapters deal primarily with nonlinear maximization, and the computation of the characteristic values of symmetric and nonsymmetric matrices.

The formal prerequisites for using this book are a good knowledge of calculus, including differential equations, and a working knowledge of elementary statistics. But another prerequisite not mentioned by the author is what teachers of mathematics call "mathematical maturity." This is a rigorous book, and while there is an emphasis on computation, particularly in the early chapters, the author has made few concessions to pedagogy. All of the theorems used are proved, and illustrative examples are held to a minimum.

In the conventional introduction to matrix algebra the student is taught the concept of a determinant, and determinants are used to invert a matrix. But Almon shares the impatience of some pure mathematicians with this approach; he relegates his short discussion of determinants to an appendix. He feels that "... determinants are of no computational—or, as far as I can see, theoretical—value. . . ." Although the theory of matrices grew out of the theory of determinants, the *idea* of a matrix logically comes first. As Macduffee pointed out in his Carus monograph "the relation of determinant to matrix is that of the absolute value of a complex number to the complex number itself, and it is no more possible to define determinant without the previous concept of matrix or its equivalent than it is to have the feline grin without the Cheshire cat."<sup>1</sup> As a nonmathematician I would not have the temerity to dispute such high authority. But in teaching the rudiments of matrix algebra to students of economics the determinant is still a useful pedagogical device. One has to point out, of course, that efficient computer programs do not use determinants—they use the pivotal process described by Almon—but it is easier to grasp advanced computational techniques once the essential notion of a general solution of a system of linear equations has been described in simpler terms.

In his treatment of linear programming Almon eschews the traditional set-theoretic introduction, and moves directly to the simplex method. Even the relatively simple transportation model is handled within this framework. There are no frills, but all of the essentials are covered including duality and shadow prices as well as the problem of degeneracy. An interesting feature of the book is a short but lucid discussion of orthogonal regression. There appears to be a growing interest among economists in the use of factor or principal component analysis, and Almon has provided a brief introduction to the theory behind this method.

Almon clearly did not have a mass market in mind when he wrote this book. Readers looking for a "mathematics made easy" approach will not find it here. But this is not to detract in any way from the author's style. His erudition shows throughout the book, and his prose while tight is unambiguous. There can be no doubt that this book will serve a useful function. The student who masters it will be more than adequately prepared for graduate courses in econometrics and mathematical economics.

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<sup>1</sup> Cyrus Colton Macduffee, *Vectors and Matrices*, The Mathematical Association of America, Ithaca, N.Y., 1943, p. v.

### Economic Systems; Planning and Reform; Cooperation

*Papers on Capitalism, Development and Planning.* By MAURICE DOBB. New York: International Publishers, 1967. Pp. 274. \$5.95.

The book under review is composed of a series of essays, some published for the first time. The compilation is in six parts: Part 1 is devoted to some problems of the history of capitalism. Part 2 reviews some aspects of economic development. Part 3 consists of reflections on the theory of investment planning and economic growth. Part 4 is on the question of investment priority for heavy industry. Part 5, by far the largest, covers planning and the Soviet economy. Part 6 is an introduction to the Italian edition of *Capital*. This is quite a menu and even by concentrating on only a few selected essays the reviewer cannot do full justice to Mr. Dobb's writings. Reading this book is an intellectual delight. Few economists have the command of both modern economic theory and Marxian economics possessed by Dobb. Nor are there many who have the ability to clearly express complex propositions in such precise and exquisite language. One may quarrel with Dobb's views and preferences for institutional arrangements (among others, I have argued elsewhere some of the points raised in this book and have presented them in a different light) but *audire alteram partem* Dobb's writings should be consulted without fail for a superb rationalization of some aspects of the Soviet mode of economic development.

The Soviet industrialization strategy adopted an "unorthodox development sequence" by concentrating on the preferential growth and lead of the capital goods industries. It emerged as the antipode of the "orthodox sequence." In the great discussion that preceded the launching of Soviet forced industrialization, the exponents of the "orthodox sequence" argued that the first stage of development should involve the expansion of agriculture and the agricultural processing industries. Although such a development pattern might be achieved at the cost of temporary deceleration of the industrial growth rate, it is at the later stages that heavy industry should be developed. The argument in favor of developing agriculture first in the Soviet economic conditions of the 1920s stems from the reasoning that agricultural exports are the cheapest possible means of securing ultimately a higher rate of growth than could be achieved with immediate maximum forced diversion of capital to industry. Investment of capital in agriculture is generally more profitable than in industry because the capital-output ratio is considerably lower in the former and the production flow would be forthcoming from it much sooner. Whereas during the period of reconstruction of capacity only small expenditures are required to maintain the capacity intact or to slightly increase it, the returns are high and quick everywhere. But when substantial additions to existing capacity are made, or reconditioning of obsolete plants undertaken, such investments in heavy industry require larger diversions of resources and longer periods of gestation than in light industry. At the other extreme of the spectrum of opinions canvassed, the primacy of developing heavy industry and financing industrial growth predominantly by pumping-over the means from the private sector

through nonequivalent exchange was advocated for a variety of economic, political, and strategic reasons (pp. 126-39).<sup>1</sup>

Dobb explains clearly the rationale behind the investment priority for heavy industry argument. He shows under what conditions it is valid for achieving a high growth rate. His treatment should be particularly noteworthy in view of the dispute into which this "law" of industrialization has fallen in both the East and the West. "The proposition that, *ceteris paribus*, the future potential growth-rate of output will be higher the larger is the proportion of current investment devoted to enlarging the productive capacity of capital-goods industries, has always seemed" to Dobb "sufficiently obvious, once stated, to admit of little if any dispute" (pp. 110-11).

Admittedly, assuming a completely free trade with high demand elasticities, it would not matter much whether a country pursued a development path by concentrating on the output of structural steel and machinery or by indirect production. But such a situation did not prevail in the Soviet Union during the period of accelerated industrialization and in most developing countries today export capacity is limited by low demand elasticities. Also, *inter alia*, if real wages cannot be reduced further for social, efficiency, or incentive reasons, it may prove impossible to expand employment and output in capital goods industries at a rate faster than that of consumer goods (assuming full capacity, absence of technical change of a sufficiently potent labor-saving variety, and no opportunity to lower significantly the capital-output ratio). Moreover, "as the capital-goods sector grows in size, the proportion of annual net investment directed towards it will need to be progressively increased in order to boost the growth-rate further" (p. 114). Eventually the preferential treatment of this sector will be moderated.

Dobb presents two main alternatives: In the first variant the pattern of investment allocation between sectors is stabilized at the existing level. In such a case the capital goods sector will continue to grow for a while at a higher, but decelerating, rate than that of total output and consumer goods. Since the growth rate of the consumer goods sector will be accelerating eventually, an equiproportional expansion of capacity in capital goods and consumer goods sectors will emerge. Alternatively the second variant postulates that, in order to raise consumption, the priority in allocating investments may be accorded to the consumer-oriented sector (at the expense of heavy industry). But then the rate of growth of total output will decline.

Dobb argues that since the mid-1950s or so, the Soviet Union has experienced a transitional period characterized by the first variant, exhibiting a much closer approximation of rates of growth of producer and consumer goods sectors and displaying in the latter part a tendency of reduced tempo of growth. It is noteworthy that, in principle, investment priority is still accorded

<sup>1</sup> For a fuller analysis of the background and issues involved in the great debate see Alexander Erlich, *The Soviet Industrialisation Debate, 1924-1928* (Cambridge, Mass., 1960). For arguments for the "unorthodox sequence" see E. Preobrazhensky, *New Economics*, translated from the Russian by Brian Pierce (New York, 1965) and for a translation of some contributions to the discussion see Nicholas Spulber, ed., *Foundations of Soviet Strategy for Economic Growth* (Bloomington, Ind., 1964).

to heavy industry. There are indications of an emerging trend favoring the second variant. But Dobb considers it unlikely that the second variant will endure since a drastic rise in consumption would be purchased at the cost of a reduction of the overall growth rate, unless counteracted by a technical advance. Probably over the next two decades, ruling out war, something akin to the first variant will be pursued (pp. 115-16). Parenthetically, I would stress that a rapid rise in consumption standards might drastically contribute to improvement of the system's efficiency through its effect on productivity—as Soviet research seems to bear out.<sup>2</sup> A significant additional source of growth could be released by raising economic efficiency.

Dobb calls attention to the changing scene in the Soviet Union and some East European economies where labor reserves have been exhausted and where there are alarming signs of labor shortages. Whereas previously growth of industrial output was largely achieved by extensive methods, now industrial output must increasingly be expanded by improving productivity—which was indeed the propeller of modern economic growth in the West—achieved mainly by capital deepening. But technical innovations could be of a capital-saving and labor-saving variety. As productivity might be increased without concomitant increases in capital outlays, a case for the preferential growth of the capital goods industry cannot rest on a prediction of a likely trend in the capital-output ratio (p. 121).

On reading Dobb's illuminating discourse one is faced once again with the question: How would the Soviet economy have developed had other alternatives, presented during the industrialization debate and later discarded, been adopted? But, given the chosen path of development, there is much to be said for Dobb's view that, when the paramount objective was super-rapid industrialization, the planning problem was essentially one of keeping "the circular production-flow moving smoothly without interruption" and under such conditions the principles of Pareto's optimum were irrelevant (p. 194). There are certain logical consequences of adopting such a planning system. Among them, the role of producers' prices is then not as irrational as it seems to the Western observer. Dobb sees the fundamental weakness of the Soviet price system as that of encouraging the squandering of capital. In the past Marxists had paid little heed to microeconomic processes of adjustment. Dobb devotes much space to a discussion of optimal planning and prices. He considers that insufficient attention is being paid by the debaters to modifying production conditions and to the distinction between the "normal" price and the "short-term" price (equilibrating current demand and current available supply). For purposes of effective economic calculation not only "short-term" prices are relevant, but "once the problem is widened to include the alteration and adaptation of supplies themselves as inputs, one cannot proceed further without some standard 'normal' price with which the current short-period market price can be compared" (p. 200). Dobb argues that in a planned economy adjustments are made by varying the production-flow. Price flexibility is "necessary only in the case of particularly stubborn supply-inelasticity" (p. 202). For invest-

<sup>2</sup> Cf. A. L. Vainshtein, *Ekonomika i matematicheskie metody*, No. 1, 1967, pp. 25-28.

ment decisions, future valuations rather than current scarcity relations are relevant. Generally, in Dobb's opinion, the crucial issue is to "get macro-price-relations approximately 'right,' and that if this be done micro-price-relations can mostly be left to look after themselves" (p. 241).

Had greater weight been given to the market in the process of development, I would be inclined to think that some of the dislocations, low productivity, and inefficiencies might have been averted. But whether market socialism would have produced better or worse results (in terms of the regime's leaders' objectives) and what would be the optimum combination of command and market-type instruments during the various stages of development are thorny issues. This brings to mind the present alterations in working arrangements taking place in the Soviet Union and Eastern Europe and the close interrelationship between the growth strategy and the functioning of the system.

On the occasion of Mr. Dobb's retirement from active teaching duties at the University of Cambridge and Trinity College, the reviewer would like to pay homage to this great scholar and true gentleman and wish him many more years of productive work.

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*Marx's Economic Predictions.* By FRED M. GOTTHEIL. Evanston: Northwestern University Press, 1966. Pp. xv, 216. \$7.50.

*Soviet Economic Controversies—The Emerging Marketing Concept and Changes in Planning, 1960-1965,* By JERE L. FELKER. Cambridge, Mass. and London: Massachusetts Institute of Technology Press, 1966. Pp. x, 172. \$5.95.

These two books, although disparate, lend themselves to review under a common rubric. Fred M. Gottheil's *Marx's Economic Predictions*, among its other weaknesses, is inexcusably obsolete, while the great strength of Jere L. Felker's *Soviet Economic Controversies* is its timeliness.

The task which Gottheil set before himself will strike many economists as being a strange exercise in scholasticism: "This present study attempts to evaluate the Marxian economic predictions. The object here is not to pronounce judgment on the accuracy of the predictions in the historical sense but rather to determine the bases upon which the predictions were made and then to evaluate the predictions as derivatives from the assumed bases" (p. 4). Any attempt to test "the reality of the theoretical structure" is "not the purpose of this book."

The first section, approximately half of the book, is devoted to a pedestrian formalization of Marx's economic model. The second, and even less adequate, half of the book attempts to determine if Marx's economic predictions follow from his economic model. The impression that Gottheil is ignorant of the existing literature concerning Marx's analysis is reinforced by his bibliography of works by authors other than Marx and Engels. It is composed of six entries, four books, and two journal articles.

The result of this neglect of previous studies is that Gottheil offers nothing new, and what he does offer has been presented better elsewhere. His attempt

to show the relationship between the economic model and Marx's predictions concerning the falling rate of profit and the absolute impoverishment of the working class is much inferior to that developed by Paul M. Sweezy in *The Theory of Capitalist Development*. His presentation of the international implications of Marx's model is pale compared to that developed by Rosa Luxemburg in her *The Accumulation of Capital*. Gottheil's presentation of Marx's "time of turnover" of capital encompasses approximately four pages (pp. 77-78, 106-10) and includes three formulas, eight symbols, and two numerical tables. A superior presentation appears in a single paragraph in the second chapter of Joan Robinson's *An Essay on Marxian Economics*. A continuation of this list would be depressingly easy.

In Part II of the book, Gottheil follows each chapter with a listing of Marx's "predictions." This exercise in taxonomy classifies predictions as "primary," "secondary predictions related to primary," and "specific." The last category might better be called anecdotal, referring to "definite dates, names or events" (p. 115). Thus, at the end of the chapter entitled "The Proletarian Revolution," we find 55 predictions. The first is the "primary" prediction that "The proletarian class cannot rise without upsetting all existing relations of production," and the last is that "The English Established Church will more readily pardon an attack on 38 of its 39 Articles than on 1/39 of its income" (pp. 187-90).

Although this reviewer is not among them, some economists might find a complete compendium of Marx's predictions useful. However, even these economists would be disappointed. Gottheil's source material is not only limited to that part of Marx's writing which is available in English, but not even all these sources are fully utilized.

*Soviet Economic Controversies* is a refreshing contrast. Felker draws upon both Soviet and Western literature concerning economic developments in the U.S.S.R. during the past decade. His presentation of current Soviet economic debates, a virtual day-by-day account, deserves to be widely read.

Felker's central concern is fortunately broader than indicated by his statement that "(T)his study is an inquiry into the reasons behind the recent shift in emphasis toward the consumer . . ." (p. 6). "Emphasis toward the consumer" was probably not a major impetus behind the recent Soviet economic reforms. The impetus can better be found in macro-economic developments, most notably a decline in the rate of economic growth and a marked increase in the capital-output ratio. For reasons that can better be pursued elsewhere, the Soviet economy somehow outgrew the Stalinist system of physical and direct planning. The antithesis posed in Peter Wiles's stimulating article "Growth versus Choice" (1957), if it ever existed, seems to have been transformed in good Marxist fashion into a synthesis. It appears that the recent reforms adopted to promote economic growth also involve a greater degree of market orientation and consumer choice.

These changes, which emphasize the maximization of profit per unit of invested capital, are generally known in the West. Their partial adoption has led some American journalists and Chairman Mao to maintain that the Soviet Union has "taken the capitalist road." Less known, and most admirably cov-

ered in Felker's study, is that these reforms had to vie with a different set of proposed measures that involved the "normative value of processing." Proponents of this N.V.P. approach also held that the Stalinist "gross value of output" success indicators were inadequate. In broad outline, they proposed that enterprise performance be measured in terms of a series of "normed" costs for value added output. The debate was often acrimonious, with anti-profit dogma on the side of N.V.P. and economic rationality clearly on the side of Liberman and his allies. Felker's account of this debate shows how fortunate it was for the Soviet economy that several fine economists managed to outlive the Stalinist era.

Only when Felker turns to an evaluation of the proper solutions for Soviet economic problems, is his discussion unsatisfactory. With the single exception of a footnote on the "Edsel" debacle (p. 139), he consistently judges Soviet practice against Western theory. Naturally, the former is found lacking. Felker's insistence that the unhampered free market is the *sine qua non* of economic rationality and human well being is simply inadequate. Only what must be described as an economic ethnocentricity can account for his apparent position that the Soviet refusal to adopt "market-oriented" methods such as massive Western-style advertising is due to simply a lack of Marxist "theoretical justification" (pp. 153-55).

Finally, two very irksome mistakes appear throughout the book. First, Felker appears to be unaware of the Marxist distinction between "socialism" and "communism" (pp. 19-20, 24, 30, 130, 152). For the Soviet economist, the U.S.S.R. is still at the stage of "socialism," "Communism," with its rule of "distribution according to need," is yet in the future. Thus Felker meaninglessly upbraids Soviet society for its failure to recognize that it does not follow "communist" principles. Secondly, Felker holds that Stalin "accepted" and "revived" (see pp. 18, 30, 31, 122) Say's Law. While this seriously misrepresents Stalin's position concerning the desirability of suppressed inflation, for the much-maligned Jean Baptiste Say it is virtually slanderous.

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*Price Formation in Various Economies.* Proceedings of International Economic Association Conference, 1964. Edited by D. C. HAGUE. New York: St. Martin's Press, 1967. Pp. xviii, 281. \$8.50.

The path toward the creation of a genuine and continuing dialogue between Eastern and Western economists has proved to be full of pitfalls. Many continuing exchanges between economists have developed on an informal basis and the present state of economic thought in the two areas suggests that a much more extensive exchange should be quite feasible. Despite the presence of several extremely interesting pieces, the present volume clearly illustrates the barriers to understanding that existed on both sides in 1964, and in large measure continue to exist.

Judging from the contents of this book, the conference does not seem to have been "paying special attention to similarities and differences between



methods of pricing in capitalist and socialist countries," as the dust jacket avers. The papers themselves are divided into three groups. The first, "pricing under capitalism," deals with such things as reaction-path analysis of duopoly, the static analysis of retail trade with spatial discrimination introducing an element of monopolistic competition, a socio-political framework for the economic analysis of the large business, a survey of price regulation in publicly controlled industries in the United States, and the determinants of inflation in the United Kingdom. The second, "pricing under socialism," contains three very brief discussions of some aspects of price formation in Czechoslovakia and the Soviet Union, and a more or less wage-numéraire analysis of efficient short- and long-run pricing. The final section contains pieces on the economic analysis of indicative planning, a two-period, linear-programming, sectoral-planning model, an analysis of the recoupment period and efficiency pricing, and a survey of some considerations of pricing for investment choice under socialism. The authors of the first group of papers are from capitalist countries, those of the second from East bloc countries, and those of the third of mixed origin. There is a 50-page summary of the discussions at the (ten-day) conference, which constitutes a quite detailed and useful review of most of the papers.

Among the most interesting papers for this reader was J. N. Wolfe's survey, from the point of view of conventional economic theory, of the possible functions of a planning board which has no power to implement its plans. Among the points made are that economists are not well prepared to develop the possibly useful information: for example, the correction of malfunctioning market adjustment mechanisms by informational activity would seem feasible, but the theory of adjustment is not yet well enough developed to provide clear guidelines for work. Also such a board in the service of a government becomes a pressure group and this may well reduce its primary asset as a toothless planner, its credibility.

J. Johnston's paper summarizes studies of the determinants of wage and price level changes in the United Kingdom, showing the general consensus that changes in excess demand are an important factor. He then points to the weakness of econometric work based on *ex post* data in dealing with this problem, since it does not separate out supply factors from demand factors. Finally, he sketches one possible way of getting at excess demand by hypothesizing an output response function which, above some base level relates increases in demand to increases-in-output response, with the latter increasing at a diminishing rate. In the discussion the above-mentioned weakness was generally conceded, but opinions differed as to what might be done about it. Both Johnston and Wolfe raised issues that are of first importance in the socialist countries; it is unfortunate that no attempt was made to provide comparable analyses for some of those countries.

Two papers are quite revealing, in a similar context, of the different styles of approach to problems that still characterize East and West. J. Lipinski's discussion of the recoupment period begins with a model in which labor is an efficient measure of cost and the recoupment period an efficient price, and proceeds to relax the restrictions. However he always assumes that at least the

ratios of final demands for the various output are fixed. H. Barkai in his lucid discussion of the recoupment period does not feel constrained to begin with a labor value model, places considerable emphasis on general economic interdependence as a hindrance to the use of the recoupment period in efficient pricing, and advocates "far-reaching decentralization" as the appropriate response to interdependence. These two papers stimulated the principal comparative discussion of pricing practices recorded in the summary.

The basic difficulty faced by organizers of a conference such as this is that too many of the Western contributors want to discuss relatively narrow and technical improvements in the received theory while too many of the Easterners want to deal primarily in rather grand and vague generalizations, while communication—and excitement—would probably be maximized if precisely the reverse were done. Surely it would have helped some if each group of authors were of mixed origin; still better would be the assignment of some explicitly comparative papers. The editor and principal organizer of the conference "wishes it were possible to start all over again, not now from the beginning, but from the state of mutual understanding and respect reached at the end of the meeting." It would be most useful if he did try again. In the meantime we are grateful to him and to the sponsors of the conference for generating several papers that economists generally will wish to read.

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*Plan and Market under Socialism.* By OTA ŠIK. Prague: Academia, Czechoslovak Academy of Sciences; White Plains, N.Y.: International Arts and Sciences Press, 1967. Pp. 382. \$12.00.

Professor Šik is a member of the Central Committee of the Communist Party of Czechoslovakia and Director of the Economic Institute of the Academy of Sciences in Prague. The book under review is a translation of a substantially revised Czech text, published in 1964. It condemns direct central planning in a developed socialist country, and advocates a far-reaching replacement of central economic command by material incentives and allocational functions of markets.

In Part I Šik takes to task "Stalin's erroneous methodology," his insistence on the "primacy of production without regard to different phases of the production process," his neglect of the "distribution theory" (by the latter Šik obviously means not only theory of distribution but also theory of intermediate and final demand), and his refusal to recognize the importance of market relations ("commodity-money relationship") in the socialist sectors of national economy. The author finds that much of Stalinist economic theory has survived Stalin in the USSR, but he has words of praise for the Polish economists, especially for Oscar Lange. He then discusses what he considers to have been the outcome of the old Soviet economic model in Czechoslovakia, the so-called "extensive development." By this he understands economic growth based on rapidly increasing input of capital accumulated through forced saving, and on rapidly increasing input of labor, while the productivity of these factors is stagnating, or even decreasing. One aspect of "extensive" develop-

ment is a tremendous rise in the incremental capital-output ratio. Šik measures this somewhat inaccurately by "investment in production per one koruna of annual increment in national income" (the latter defined as net material output at constant market prices). In these terms, the ratio jumped from 2.01 in 1958 to 13.90 in 1962 and 18.22 in 1963. Other characteristics of "extensive growth" are waste of material inputs, increasing cost of production, accumulation of unsaleable inventories of intermediate and final products, and losses in foreign trade.

Sooner or later, "extensive development" becomes self-defeating and the only possibility of sustaining growth is an "intensive development" under which an improved quality of factors, especially better technology, and an improved allocational efficiency become the main sources of growth. The necessary prerequisite, according to Šik, is a consistent use of socialist market relations in the framework of indirect macroeconomic planning.

In the lengthy Part II, the author argues in favor of decentralized economic decision-making by socialist managers who are supposed to "maximize gross income of the enterprise." Gross income is a misnomer: essentially it is total revenue minus material cost, that is, a loose analogy to the Western concept of value added. Obviously, it is impossible to maximize value added unless there is no scarcity of factors; and a profit-maximizing firm would tend to maximize value added only if the price of primary factors is zero. What the socialist firms actually may maximize in Šik's model is the *residual* of "gross income" after payment of centrally fixed wages, of interest on loans, and of special levies or "charges" on employment, on working, and on fixed capital. What is left thus comes close to the Western concept of a firm's profit. If a quasi-profit-led socialist market economy is to operate without return to direct central controls, prices must not deviate dramatically from relative cost to producers and from relative preferences of buyers. Šik's emphasis on the "movement of prices" to secure "a continual surmounting of contradictions between the narrow interests of producers and the narrow interests of consumers" is of special interest in this connection.

Problems of socialist price formation are further discussed in Part III. Unfortunately, this is an almost impenetrable mixture of the Marxian construct of "production price" and a vague theory of equilibrium prices on the wholesale and retail level.

With the exception of the equation of the production price (p. 250), based on a questionable, linear cost function, no functional equations and no graphs are used to inquire into the interrelationship of the prices of products and inputs. Šik seems to have no clear concept of production and consumption functions. He also seems to make no clear distinction between static partial market equilibria, a general equilibrium, and an insufficiently identified concept of optimality. What is especially surprising in his discussion of the blessings of (hopefully competitive) socialist markets is the virtual absence of inquiry into the problems of external economies and diseconomies, into the different time horizon of the managers and workers who receive short-term bonuses on one hand, and of the long-term oriented planners on the other, and into the possible conflicts between static efficiency and some macrodynamic goals.

The final Part IV deals with "money under socialism." A major portion of it is devoted to foreign trade and the balance of payments. While probably not realizing that "purchasing parity exchange rates" are not tantamount to equilibrium rates, Šik makes a laudable effort to recommend the removal of "artificial barriers" between domestic and foreign trade prices under a more realistic exchange rate of the koruna.

Those readers versed in quantitative economic analysis will feel somewhat frustrated by Professor Šik's vague, non-interrelated theorems, his failure to define clearly the parameters and the variables of his model, and his apparent lack of profound knowledge of modern Western theory. Even those readers who are interested in socio-economic systems rather than in pure economic theory may find several arguments either inconsistent or arranged in a very unusual sequence, many terms and many statistics underdefined, and the translation shaggy. Yet, despite all of its imperfections, this is an important study in political economy. Anyone who is interested in the changing economic systems in Eastern Europe and in the changing Marxist economics should not fail at least to leaf through it. It shows the painful Communist rediscovery—and perhaps even a certain overrating—of the allocational role of markets as well as the still substantial, but obviously narrowing, gap between Western and East European economic thought.

To be fair to the author, one should bear in mind that his interest is not limited to economic matters. In several chapters, he also discusses a general reform of a socialist society. His call for decentralization of economic power has contributed to the recent "socialist democratization" of Czechoslovakia.

JAN M. MICHAL

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*Economic Systems.* By GREGORY GROSSMAN. Englewood Cliffs, N.J.: Prentice-Hall, 1967. Pp. viii, 120. \$4.95; paper, \$1.75.

This volume in the Foundations of Modern Economics Series provides a long-needed concise survey and summary of the field of comparative economic systems. It consists of eight short chapters—three introductory chapters dealing with performance criteria, economic institutions, and ideologies; two chapters on laissez faire and regulated capitalism; case studies of the Soviet Union as a command economy and Yugoslavia as a socialist market economy; and a concluding chapter summarizing some of the main points of the book and evaluating their significance.

The book can be used effectively at three different levels. First, it will admirably serve the main purpose of its series as a supplement to principles texts. The discussion of economic systems is commonly the weakest section in a principles text, usually appearing to be an afterthought following the extended treatment of the U.S. economy to which the book is really devoted. This approach unfortunately ignores the very strong student interest in alternative economic systems and their similarities and differences in comparison with the regulated capitalist economy, of which the United States is only one example. Students and teachers alike will welcome this volume as an introduc-

tion to a basic subject which their principles texts slight, if not ignore.<sup>1</sup>

Second, though not designed primarily for use in specialized intermediate-level courses in comparative economic systems, the book can be used with profit in these courses to provide a brief but comprehensive and authoritative overview of the subject. The price of the paperback edition is low enough to permit its purchase along with one or more of the longer texts and/or readers in the field. Instructors and students will find that Grossman's volume supplements rather than duplicates these volumes.

Finally, the book will be of interest and benefit to instructors because it provides an excellent concise summary of the field, with insights and examples that will find their way into lectures. The text contains many helpful references directing readers to both seminal literature and significant contemporary discussions. A list of selected readings at the end of the book indicates other important titles in the field. The book itself is well indexed.

Throughout, the approach of the book is analytical rather than descriptive, although enough factual material is presented to buttress the theoretical and institutional analysis. The treatment of the various topics is sophisticated and comprehensive, considering political and social aspects where relevant. At the same time broad and deep, it reveals Grossman's unusual grasp of the field of comparative economic systems. In dealing with controversial and ideologically sensitive matters, he is fair and judicious, cautioning the reader, for example, against improper comparison of an idealized model of capitalism with imperfect Soviet reality. Most striking is the fact that his case studies are presented and analyzed within the theoretical framework developed at the beginning of the book. This feature provides a coherence lacking in a number of books in the field, which fail to apply in the case study portions the basic concepts set forth in the earlier "theoretical" chapters. The literary style is clear and many specific examples are included to illustrate points, although some readers may find the sentence structure difficult at times because of the frequent insertion of parenthetical qualifications.

This reviewer was particularly pleased with the treatment of a number of topics, including the comparison of the abstract laissez faire perfect-competition model of capitalism with the complex reality of modern, imperfect, regulated capitalism; the nature and features of planning (commonly overlooked in principles texts); direct vs. indirect controls; the pros and cons of nationalization; a brief survey of the different types of economic planning in selected West European countries; and similarities in the bureaucratic nature of enterprise management in large private and public enterprises in the West and public enterprises in the East.

A reviewer of such a concise survey can always identify topics which he wishes rigid space limitations had not prevented the author from discussing further, or indeed discussing at all. Thus, for example, I would have liked a more explicit treatment of the central planning model, some mention of fascism in the chapter on ideologies, and an explanation of the role of producer

<sup>1</sup> A notable exception is Heinz Kohler, *Scarcity Challenged: An Introduction to Economics*, New York, 1968, which compares how different economic systems attempt to deal with the same problems.

cooperatives in Yugoslav agriculture, where co-operation is considered an economically and ideologically acceptable compromise between individual and collective enterprise. However, I would be hard pressed to designate what should be eliminated to make room for these and other possible topics, given the severe space limitations imposed on the author by the format of the series of which the book is a part.

Although this is not the place to list minor misprints and errors, one which may confuse or alarm some readers should be mentioned. The table of contents incorrectly lists Chapter 7 as dealing with "The Soviet Market Economy: Yugoslavia." In the chapter itself, Yugoslavia is properly described as possessing a socialist market economy which emerged as a reaction to experience with the Soviet-type economy.

MORRIS BORNSTEIN

*The University of Michigan*

### Business Fluctuations

*Information, Expectations, and Inventory Fluctuation: A Study of Materials Stock on Hand and on Order.* By RUTH P. MACK. National Bureau of Economic Research Studies in Business Cycles, No. 16. New York: Columbia University Press, 1967. Pp. xii, 306. \$10.00.

For more than a decade, Dr. Mack has studied inventory fluctuation and its place in the vertical production-sales sequence. In this major work on the inventory behavior of department stores and durable goods manufacturers, analysis, as in her earlier works, is focused on the impact of shifting market conditions on stocks. The topic is complex; relevant data are scarce and, as Dr. Mack notes, the subject lends itself poorly to formal analysis. The importance of the topic and the high caliber of her analysis, however, should reward the determined reader. For the specialist in this field, this is an essential book.

In the first three chapters the author summarizes briefly the inadequacies of existing explanations of inventory behavior, explains the uses and determinants of stock holding by business enterprises, and describes the time-series data to be used in examining the vertical sequence of flows and stocks. Chapters 4 through 8 contain a detailed exposition of how materials stocks and outstanding purchase orders for materials behave. The two combined—termed "ownership"—are examined separately and in combination for durable goods manufacturers and for department stores, using the National Bureau's business cycle chronology. In Chapter 6, rates of change are also discussed, while flows which bound stocks levels—sales and new orders to suppliers—are analysed together in Chapters 7 and 8. Chapter 9 to 13 are devoted mainly to explaining the findings. The link with sales as well as conditions in markets in which materials or merchandise are purchased are examined for their contribution to fluctuations in ownership. Rough sketches of the inventory models seemingly most appropriate for department stores and for durable goods manufacturers are then given. The contribution of inventory and purchase orders to business cycles is shown next. The book concludes with a chapter in which an "ecologi-

cal" theory of inventory behavior is offered, centering on the concept of ownership.

The concept of materials ownership, which comprises materials stocks on hand and on order, is the hallmark of this book and the author's earlier work. What Dr. Mack has done, in effect, is to redefine the dependent variable employed in most inventory models where the behavior of stocks alone or of changes in stocks is viewed as a lagged function of sales or expected sales and unfilled orders. These models are essentially sales-accelerator models, dating back to Lloyd Metzler's pioneering work in the 1940's, that employ a form of period analysis in which businessmen adapt production to changes in sales only with a lag, thereby generating changes in inventories. Despite later refinements (Richard Goodwin's "flexible accelerator," the incorporation of distributed lags, the more sophisticated sales-expectations hypotheses of Michael Lovell and others) the models have remained unsatisfactory in several respects. Dr. Mack argues that the sales relationship fails to explain a large and varying portion of inventory behavior; when unfilled orders (dominated by backlogs of orders for machinery and equipment) are included, they explain too much; a larger portion of inventory investment is unintended than seems to make sense.

By redefining the inventory variable to include stocks on order, the author has shifted the emphasis to avoid or mitigate these problems. The impact of sales on inventory behavior is now shared with materials markets conditions. The ease of placing purchase orders allows sufficiently rapid response to actual or perceived market changes so that unintended stocks can be ignored (p. 211). The benefits which derive from this change in emphasis, however, may be offset by the author's failure to consider stocks held at higher stages of fabrication. She examines neither the relations between materials, in-process, and finished stocks nor the behavior of the total. Observed relations between sales or other variables and ownership may not be duplicated, for example, in the link between stocks of finished goods and sales. More important, changes in holdings of in-process and finished stocks may be competitive with the sales link and market conditions, the two principal causes of fluctuation in ownership examined.

Ownership behavior is illustrated mainly through time-series data (1946 through 1963) on sales, stocks, and outstanding purchase orders for a sample of large department stores, and through information for a similar period on shipments, stocks, and outstanding orders of durable goods manufacturers. As Dr. Mack notes, the data are not ideal mainly because the vertical chain of demand cannot be extended backward to show sales and purchases for supplier firms, and because the vertical sequence for durable goods manufacturers is distorted by over- and under-inclusiveness of the statistics. An admirable job has been done to overcome such difficulties by incorporating information on spot metals prices, vendor performance, and other material which helps to reveal conditions in materials markets. The author is scrupulous about acknowledging sources of weakness in her results, but one potential difficulty inherent in the use of highly-manufactured time series in the context of the National Bureau's business cycle chronology is not brought out. Measures of lead and lag and measures showing percentage of months in like phase for dif-

ferent series are used to establish regularity of relationships. When time series are smoothed by using moving averages, lead-lag relationships and measures of conformity may be sensitive to the smoothing technique employed. The possibility should not be ignored.

At the risk of oversimplification and bluntness of emphasis, results can be summarized as follows: average materials ownership during the period was large relative to sales or shipments; outstanding orders were more important relative to stocks for durable goods manufacturers than for department stores; ownership and its components conform to postwar business cycles; swings in outstanding orders are larger than those in material stocks and lead, especially at cycle peaks; a long lead in change in outstandings over inventory investment at peaks for manufacturers is not matched for department stores; during early expansion, outstanding orders and ownership display a more than proportional rise or thrust; new purchase orders of department stores have a "whip" effect in which such orders rise and fall by a large multiple of the *subsequent* changes in sales; for durable goods manufacturers, unlike department stores, sales and purchase orders are roughly synchronous; durable goods manufacturerers maintained a much looser sales-inventory objective than department stores; the proportion of fluctuation in ownership explained by sales, even under the most conservative hypotheses, is relatively small.

Fluctuations in ownership must thus be explained by other variables in addition to sales: conditions in materials markets and the possible influence of profits on attitudes toward inventory handling costs are chosen as additional, likely determinants of ownership behavior. The analysis is extended to cover the phenomenon of ownership thrust, for example, by examining probability distributions attached to price expectations and "the proclivity to gain from price-timed buying," various response lags, and the feedback which leads to self-reinforcing expectations. This is what seems to be meant by the author's term "ecological process" in the context of inventory analysis.

The book concludes with a description of an inventory cycle generated by price-timed buying, suggested directions for further study, and a warning of the difficulties likely to be met in adding quantitative dimensions to the model by the application of econometric analysis. These difficulties have all been met before and one would hope that they are not insoluble here, for in deriving an ecological model of inventory behavior, the author has in effect issued an invitation to establish the quantitative significance of the relationships she has set forth so well.

P. W. KUZNETS

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### **Money, Credit, and Banking; Monetary Policy; Consumer Finance; Mortgage Credit**

*Les choix financiers et monétaires: théorie et technique modernes.* By S.-CH. KOLM. Paris: Dunod, 1967. Pp. viii, 331. F 58.

Professor Kolm's elegant and compact, beautifully produced treatise on financial-portfolio choice merits careful scholarly attention (which will be



impeded by his failure to provide indexes, although the book has many detailed analytical conspectuses). Since the book mostly is synthetic rather than plastic and problem-oriented (although exercises are avoided), it probably has special interest for graduate students. Indeed, as I explain below, *Les choix* may be a little too pat: perhaps economics, at heart, is intractable to science-engineering approaches. And, for me much of modern French economics—technically brilliant, calling for much more attention than Anglo-Saxons are paying to it—evokes this same unease.

The 18 chapters of *Les choix* are distributed amongst three parts. The first centers on the role of risk in portfolio-selection theory, the second on theorems of optimal portfolio choice defined on mathematically well-behaved sets, the third, *Les actifs de paiement*, on demand for money, emphasizing inventory theory, together with some "Patinkin Business," including "money in the utility function," "invalid dichotomies" and the Walrasian formulation of monetary demand. Kolm has complete mastery of his materials whilst gracefully deploying a formidable mathematical technique over virtually the whole range of the theory of portfolio choice. So, nodding to Dr. Markowitz, he makes portfolio-choice theory virtually as accessible as are the theory of producers or macrodynamics.

I might raise four critical points. First, insufficient attention is paid to the highly subjective nature of the relevant expectations: much deeper analysis of Bayesian statistics and implications of impossibilities of parameter specifications is called for. Secondly, and related to (1), the role in life of information costs and of the theory of information search is much more important than its bit part in *Les choix* (cf. pp. 54-66). Thus Kolm's problems mostly concern maximization of a utility function over feasible-portfolio sets relative to parametric risk properties. But in life the investor must be seriously concerned with (admittedly subjective) confidence limits attached to estimates of variances of yields, market prices, etc. And these properties can, so to speak, be produced by the investor through information search: the stochastic properties of alternative portfolios are endogenous in realistic problems. So the nexus is rather more complicated in a very important way than Kolm's central analysis suggests: not only in bridge is a peek worth two finesses. (To be fair, Kolm interestingly analyzes the problem of changing the portfolio space itself.) Thirdly, the treatment of sequential choice is but slight, although references to dynamic programming and the Pontryagin Maximum Principle reveal Kolm's awareness of this topic. Still, perhaps it makes little sense to worry about extended economic horizons so long as information lacunae are so gaping and fads and hysterias are so important in bourses. Fourthly, the discussion of demand for money (mostly in Part 3) is unsubtle. Are not financial spectra so dense that particular substances, labelled "M" for various practical purposes, cannot categorically be singled out for purposes of portfolio theory? A single illustration suffices: how different is unused overdraft facility from "M" in a theory of *la dynamique d'encaisse*? Paradoxically, one of the great virtues of the first twelve chapters of *Les choix* is that they make it so easy to see why financial spectra are so dense.

The weight of my criticisms is slight in the balance.

Finally, a few words about implications which may be drawn from *Les choix* for the theory of monetary policy. Its bulk leads up to important implications only in statical general-equilibrium models of economic policy à la Tinbergen; thus changes in the term structure of interest rates sustained by debt-management authorities would feed into portfolio-optimization programs, leading up to changes in excess demands for financial paper, finally influencing commodity markets. I much doubt if Kolm's austere algebra could handle short-term effects of a drastic credit squeeze leading to loan recalls, irregularly plunging share prices, rumors of revaluation of gold, etc. *Les choix* does not much penetrate the operational problems of portfolio managers in untr tranquil conditions, possibly because Kolm finds bourses uncomfortable. Perhaps this is fortunate: a City man could not have produced this beautiful book.

M. BURSTEIN

*The University of Warwick*

*Essays in Monetary Economics*. By HARRY JOHNSON. Cambridge, Mass.: Harvard University Press, 1967. Pp. 332, \$7.50.

In his preface Harry Johnson writes: "This volume brings together essays and articles in the general field of monetary economics prepared for a variety of purposes over the past four years. The main reasons for collecting them in this fashion are that they appear to have been found useful for teaching purposes . . . and that they have been published in widely scattered . . . volumes." There are three parts to this book. Part I contains his survey of monetary theory, published, in the *AER* (1962). It is followed by two lectures which resurvey "much the same material, but at a less difficult level. . . ." Chapter 4 contains some material which has not been published before, and "deals in what is hoped is a relatively simple way with the complex problem of the role of money in growth models." Parts II and III are devoted to policy problems. The former discusses monetary and fiscal policy in the United States and Canada; and the latter is concerned with these problems in developing countries. Every chapter is lucid. The exposition represents a balanced judgment of recent thinking; and alternative points of view are considered fairly.

It is advisable to concentrate upon Chapter 4 which contains material which has not heretofore been published. This chapter is a development of James Tobin's 1965 paper in *Econometrica*. Three aspects of this chapter will be discussed.

First, Johnson maintains that when the utility yield on real balances is explicitly considered, a rise in the rate of price inflation could either raise or lower the long-run capital intensity. That is, the ratio of real savings to output could either be raised or lowered by such a policy. Tobin defined disposable income per worker  $y'$  as  $y + bgy$  where  $y$  is current output per worker and  $bgy$  is the current increment of real balances per worker. Variable  $g$  is the growth rate of real balances equal to the growth rate of output and  $b$  is the (desired equals actual) ratio of real balances per unit of current output. Consumption per worker was  $(1-s)y'$  in Tobin's model. Johnson

defines disposable income per worker as  $y'' = y' + u(b)y$  where  $u(b)y$  is the imputed value of real balance services per worker, measured as an integral under a demand curve. Consumption of goods per worker is  $(1-s)y'' - u(b)y$  and  $u(b)y$  is consumption per worker of the services of real balances. We, therefore, derive (1) the ratio of consumption of goods per unit of current output  $c/y$  or (2) the ratio of real savings (investment) per unit of current output  $s^*/y$ . These ratios sum to unity.

$$\begin{aligned} (1) \quad c/y &= (1-s)[1 + bg + u(b)] - u(b) \\ (2) \quad s^*/y &= s[1 - (1/s - 1)bg + u(b)]. \end{aligned}$$

The demand for real balances per unit of output  $b$  is negatively related to the proportionate rate of price change  $\pi$ . A rise in the latter, given  $y$ , may raise or lower  $c/y$ . The partial derivative  $\partial(s^*/y)/\partial\pi$  has an ambiguous sign. Johnson concludes that the effects of a rise in the rate of price change are ambiguous in terms of their effects upon the long-run capital intensity.

This approach is troublesome for several reasons. Suppose that the economy were not growing  $g=0$  and real balances per worker were suddenly increased. What would happen to the demand for consumer goods per unit of output? From (1), with  $g=0$  and given  $y$ , we derive:

$$(3) \quad \frac{\partial(c/y)}{\partial b} = -su'(b) < 0, \quad \text{since } u'(b) > 0.$$

The demand for consumer goods will *decline* as a result of the rise in real balances per worker. This is a remarkable result which is not pointed out to the reader. Were Pigou, Patinkin, and Johnson (in the earlier chapters) wrong in thinking that a rise in real balances raises the consumption function for goods? Johnson does not derive his consumption-savings function from any explicit model of consumer behavior as did Uzawa, Sidrauski, Samuelson, and Diamond. The consumption function is simply postulated. We may, therefore, conclude that: either Johnson's function is correct and Pigou, Patinkin, etc., were wrong about the direction of the real balance effect or that Johnson's function is not a correct description of savings behavior.

Second, he asserts "that what is basically responsible for the nonneutrality of money in the models analyzed is the assumption that money is . . . an asset with a return fixed in nominal terms. . . ." Unfortunately, no proof of this statement is presented in the form of a model; and the reader is not likely to be convinced. The essence of monetary growth models is that an additional store of value is introduced which has an endogenously determined real yield: the nominal interest on money plus the rate of deflation. Variations in the growth rate of this asset affect the equilibrium yield on real capital. Johnson writes: ". . . neutrality would be assured by assuming that monetary arrangements guarantee holders of money a rate of return on their real balances equal to the rate of return available on real investment." His suggestion, in effect, assumes away the problem of determining the yield on money as an endogenous variable. Is this interesting? Does he not thereby discard one independent store of value?

Even if all money were of the inside type, nonneutrality could be produced. Following the spirit of his model, disposable income would be  $y^* = y + u(b)y$ : to the flow of output of goods (exclusive of the services of real balances) add the flow of services of the real balances produced by the banking system. With inside money, we exclude  $bgy$  from disposable income. The ratio of real savings to output  $s^*/y$  is:

$$(4) \quad s^*/y = s[1 + u(b)].$$

Since  $b$  is negatively related to the rate of price change  $\pi$ , nonneutrality occurs in an inside money model: i.e.,  $\pi$  affects the ratio of real savings to output. Of course, this formulation is amenable to the same criticisms that were directed to (2).

Third, Johnson tried to present a complex problem in a simple way, using graphs rather than mathematical proofs. The exposition is heuristic rather than rigorous; and many will welcome such an attempt. Others may feel that if a picture is worth a thousand words, an equation is worth three pictures. As a result of the heuristic approach the reader is not shown under what conditions the equilibrium is stable or unstable. In fact, Tobin's system (which is the basis of Johnson's model) is dynamically unstable; and Johnson's could also be unstable.

Monetary growth theory is in its infancy. In another five years we may expect from Johnson a survey of this field of the same quality as his survey of monetary theory which is reprinted as chapter one of this book.

JEROME L. STEIN

*Brown University*

*Monetary Process and Policy: A Symposium.* Edited by GEORGE HORWICH. Homewood: Richard D. Irwin, 1967. Pp. xi, 388. \$8.50.

The third annual Conference of University Professors sponsored by the American Bankers Association was held at Purdue University from August 29 to September 1, 1965. The Krannert Graduate School of Industrial Administration served as co-sponsor. This volume includes fourteen invited papers, seven discussants' comments, and other comments by participants. For reasons that are not made clear, there are prepared comments on some, but not all, of the invited papers. The major papers are by Paul Samuelson, "Stabilization Policies in the Contemporary U.S. Economy"; George H. Hildebrand, "Structural Unemployment and Cost-Push Inflation in the United States"; Albert Kervyn, "Inflation and Stabilization Policies in Western Europe"; Warren L. Smith, "Is the Growth of Private Debt a Cause for Concern?"; Tilford C. Gaines, "Financial Innovations and the Efficiency of Federal Reserve Policy"; John H. Wood, "A Model of Federal Reserve Behavior"; Frank de Leeuw, "The Demand for Money: Speed of Adjustment, Interest Rates, and Wealth"; Karl Brunner and Allan H. Meltzer, "The Meaning of Monetary Indicators"; S. Posthuma, "Harmonization of National Monetary Policies"; J. Marcus Fleming, "The International Monetary System and the Reconciliation of Policy Goals"; Hyman P. Minsky, "Money, Other Financial Variables, and Aggregate Demand in the Short Run"; Robert H. Strotz, "Empiri-

cal Evidence on the Impact of Monetary Variables on Aggregate Expenditure"; Daniel H. Brill, "Criteria for the Conduct of Monetary Policy—The Implications of Recent Research, for the Federal Reserve"; and G. L. Bach, "Criteria for the Conduct of Monetary Policy—The Implications of Recent Research, for Academia." The editor has pushed his material through to publication in a reasonably short time but not rapidly enough to avoid being overtaken by the fourth Conference of University Professors on monetary problems. (See last paragraph below.)

It is almost traditional to say at this point that "as is usually the case, these papers differ widely in quality, etc." Actually, though differences are evident, all of the contributions are serious efforts by competent investigators to rise to the occasion. Of course, a reviewer can do no more than sketch the contents of this sort of volume.

Samuelson's keynote address emphasizes the success of economic policy-making in recent years while reminding his listeners-readers of unresolved problems. Hildebrand looks into two alleged difficulties—structural unemployment and cost-push inflation—and concludes that unions have made a major contribution to inflationary pressure and unemployment in recent years. Lowell Gallaway agrees with the conclusion but disputes the analysis underlying it. Arthur Ross disputes the conclusion. Kervyn presents some interesting descriptive material on developments in Western Europe (focusing on the years 1962-1965) together with some speculations on possible future trends. Smith's paper concludes that the increase in private debt that has been taking place in the United States is not unduly worrisome. It appears to be a problem only insofar as it increases the economy's sensitivity to deflationary shocks. Though I agree with most of Jacob Cohen's remarks on the Smith paper, those interested in the subject will undoubtedly find the Smith paper plus the comments by Cohen and Roland Robinson useful reading. Gaines' paper contains many interesting observations, as one would expect when the writer is looking at monetary problems from a different point of view from many of us; but the paper is marred by his uncritical espousal of a special version of the "Gramley-Chase" thesis that the Federal Reserve has no control over the supply of money. Perhaps I should say that I am one of those economists who regard the Gramley-Chase and related views as partly right and provocative, but quite baffling in certain respects. Unless one accepts the liquidity-trap hypothesis that banks have an infinite demand for excess reserves, banks will create deposits when they try to reduce their reserve-to-deposit ratio by (say) purchasing existing assets. Furthermore, what Gramley and Chase are saying is, in part, that the identification problem extends down to the bank decision-making level. One can grant this and still argue that a money-supply hypothesis which embodies some characteristics of a reduced form may be useful.

Wood's paper is one of the most stimulating papers in this volume. Wood wrestles with a fact that everyone has always "known" but few have attacked systematically; namely, that Federal Reserve policy is an endogenous variable in the economic process. He doesn't get too far, but what he does is promising. Holding all aspects of monetary policy other than the Fed's portfolio of government securities constant, he investigates the extent to which this instrument appears to respond to target values for GNP, the balance of payments

surplus, the rate of unemployment, and the price level (for example, the target value for GNP is similar to "potential GNP" as estimated by the Council of Economic Advisers, the target for the price level is no change), and to movements in the actual values of these and some other variables. He finds that the largest part of open-market operations is ascribable to "defensive operations," but the remainder is systematically related to the targets and other variables.

De Leeuw's study is a valuable addition to econometric work on the demand for money. It is especially noteworthy for the evidence that demand responds with a long lag to changes in the parameters. See Harry Johnson's comment on this finding.

When is monetary policy easy and when is it tight? Brunner and Meltzer give further attention to this question. As they point out in a rejoinder to Samuel Chase, any endogenous variable can serve as an indicator if we have correct and complete knowledge of the system. But what if we do not? I will not try to summarize the arguments for and against their conclusion that the quantity of money in the exclusive sense is a better indicator of monetary conditions than money in the inclusive sense, commercial bank credit, interest rates, or free reserves.

I have already used up most of the space allotted to me and six major papers remain unmentioned. In a paper ranging rather widely over the assigned subject, Posthuma is relatively optimistic regarding restoration of equilibrium in the balance of payments between America and Europe. Fleming's contribution is a useful analysis of balance of payments problems that concludes with support for the "wider spread" or "moveable band" system of exchange rates. Minsky presents a "portfolio-approach" paper on the short-run impact of monetary policy which struck me, like his discussants, as a not-fully-developed discussion containing a number of promising avenues for further development. Strotz's contribution is a well-written, judicious summary of recent empirical work which, unfortunately, as David Meiselman points out, does not cover some of the most recent research. Thomas Mayer also makes some relevant comments on the Strotz paper.

Brill refers in the conclusion of his paper to his "ill-tempered remarks." In fact, he presents a rather temperate view of how recent research looks from the cathbird seat of the policy maker. (Some of the replies and rejoinders at the end of the volume are a little warm.) Bach, asked to speak for academia, does not really take a position very different from Brill's, perhaps because he has served so long in the role of consultant. Both, of course, lament the gaps in our knowledge. No responsible monetary economist could do otherwise. But I would argue somewhat with the tone of their remarks. In view of the virtual demolition of the free-reserve-concept, the resurrection of the quantity of money as a respectable instrumental variable, etc., surely the situation is significantly different from what it was ten years ago, not to speak of points in time farther back in the history of our attempt to overcome ignorance.

Tastes differ, but my award for crisp writing in this volume goes to Jacob Cohen. He did lose me temporarily where he says: "Gaines' paper, with its defense of an antiprinciple . . ." [that the Federal Reserve cannot control the quantity of money].

While I was engaged in preparing this review, the proceedings of the 1966 Conference of University Professors sponsored by the American Banking Association, edited by Harry G. Johnson, appeared as a supplement to the August 1967 issue of the *Journal of Political Economy*. Work that appears in journals is seldom reviewed in the usual sense of the term. And I was afraid that if I asked the editor of this publication for a clarification of my assignment, he would enlarge it. Suffice it to say that the fourth conference produced more papers that should be read by the really up-to-date monetary economist. Topics covered included the subject of monetary indicators raised by Brunner and Meltzer at the 1965 conference, regulation of financial institutions, balance of payments adjustment, the term structure of interest rates, and monetary experiences of less developed countries.

H. LAURENCE MILLER, JR.

Carleton College

*Incomes and Money*. By RALPH HAWTREY. New York: Barnes and Noble, Inc., 1967. Pp. xv, 260. \$7.50.

Sir Ralph Hawtreys presents a critique of postwar monetary policy. He feels that excessive reliance has been placed on incomes policy as a means of controlling inflationary pressures in the United Kingdom; incomes policy must be supported more effectively by monetary policy than has been done to date. The heart of credit policy is, as Hawtreys has maintained through the years, a "free use of Bank rate."

Nearly half of the book is devoted to a restatement of Hawtreys's familiar monetary theory of the business cycle. The prime mover in the economy continues to be the trader who expands or contracts inventories in response to small changes in the interest rate. Economic stability can be maintained only though timely changes in the central bank discount rate; the conventional attention to reserve ratios has resulted in the past in a lagged response of monetary policy to business conditions and an intensification of the business cycle.

Hawtreys recognizes that the role of the short-term rate of interest as a regulator of credit has been questioned in recent years. However, he feels that the locus of theoretical arguments against his theory is in Keynes' *Treatise on Money*, and his rebuttals are devoted to this work (pp. 72-75). He again charges the Radcliffe Committee, which in its Report concluded that interest costs bore a relatively insignificant relationship to the decisions regarding inventory investment, with misinterpreting the evidence and concludes "... that the balance of opinion to be derived from a scrutiny of the recorded evidence seems to have been very definitely on the side of sensitiveness of stock holding to the cost of borrowing" (p. 80).

British monetary policy is largely responsible, in Hawtreys's view, for the international spread of the business cycle. After the Bank of England started using Bank rate as a means of credit policy in the 1950s, British monetary policy is said to have had an impact on U.S. business conditions: "Twice a 7 per cent Bank rate in London has resulted in an unemployment percentage of nearly 7 in America" (p. 115). Thus, he believes, appropriate British monetary policy is of key importance for international stability.

The starting point of his analysis of postwar policy is a belief that the pound is undervalued and that inflationary pressures are introduced into the British economy via the export industries, creating a demand for credit and upward pressures on wages and prices. Imports, in turn, have risen in response to higher incomes; the net results has been a persistent balance of payments deficit.

Hawtrey contrasts the British and German experience: "Undervalued money has given Germany a favourable balance of payments ever since 1951. It did not do the same for Britain, because Britain never consistently kept the credit situation under control. The authorities were committed to the 'expansionist' policy, which was to ensure full employment by expanding demand" (pp. 137-38). The basis for his claim that the pound is undervalued appears in a few summary tables relating earnings and productivity in various countries. He concludes that the degree of undervaluation vis-à-vis the dollar before the 1949 devaluation was 17 per cent; undervaluation at the end of 1964 is said to have been 15 per cent. Unfortunately, it is difficult for the reader to trace through Hawtrey's computations. As further evidence of the undervaluation of sterling, he cites "... overemployment in Britain and unemployment in America" (p. 119). Nowhere does he examine the actual U.K. export performance in the 1950s and early 1960s. This discussion is unconvincing.

Hawtrey relates the lack of success of incomes policy to the undervaluation of sterling: "Up to now persuasion has failed, because the undervaluation of the pound and the consequent excess demand for labour have inexorably impelled wages upward" (p. 168). What is needed, he says, is that credit conditions be tightened by raising Bank rate whenever the wage level threatens to rise faster than the prescribed rate. His enthusiasm for incomes policy is based on his belief that the Bank of England has reacted in the past only to the state of gold and foreign exchange reserves. The incomes policy provides the monetary authorities with a practical guide for stabilizing economic activity. The responsibility of the Bank of England is, accordingly, "... of so regulating credit that the flow of money will allow the prescribed increase in the wage level, and no more" (p. 193).

It is easy to take issue with this work. But we should remember that Hawtrey wrote this book more than twenty years after retiring from a long career in the U.K. Treasury. It is splendid that he has been able to keep abreast of the events of the day and to give us the benefit of his analysis.

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## International Economics

*Capital Movements and Economic Development*. Edited by J. H. ADLER WITH P. W. KUZNETS. New York: St. Martin's Press; London: Macmillan, 1967. Pp. xxxiv, 497. \$12.50.

Long-run international capital movements (ICM) are means of unilateral resources transfer across the national frontiers to promote economic growth.



To fully understand ICM, one must be aware of the *purpose* (i.e., the economic function) and the institutional arrangement under which they take place. Topics under each heading may include:

I. *Economic Function of ICM*: (a) Causes of ICM, (i) supply of savings, (ii) demand for investment, (iii) rates of return, (iv) borrowers' qualifications; (b) Process of ICM, (i) mechanism as related to international trade, (ii) monetary accommodation; (c) Consequences of ICM, impact on production structure in the long run. II. *Institutional Arrangement for ICM*: (a) Suppliers' status, (i) private lending: corporate profit, household savings, etc., (ii) public aid: bilateral, multilateral, (World Bank, Consortium), etc.; (b) Contractual content, (i) private lending: direct, equity, bond, etc., (ii) public aid: tied to country (e.g., obligation to buy from the United States); tied to commodity (e.g., P.L. 480), etc.

This 500-page book, the Proceedings of a Conference held by the International Economic Association, tries to cover all these topics by dealing mainly with two unrelated experiences: the trans-Atlantic outflow of British private capital in the golden age of such lending in the period 1840-1915 and the post-World War II flow of public (mainly U.S.) funds to underdeveloped countries through foreign aid programs. Sixteen papers are divided into three parts. We shall refer to the tabulation above to facilitate our discussion of the papers.

While the British experience is an accomplished historic fact, the contemporary experience of foreign aid is an experiment still in progress. For this reason, it is possible for the analysis of the British experience (Pt. I, "The Historical Record," 200 pp.) to concentrate heavily on the economic aspect (topic I in the above table). In contrast, much of the analysis of the contemporary experience (Pt. II, "The Resources Aspect," 170 pp.) has to do with the design of the institution of foreign aid [topics II a (ii) and II b (ii)], which must be concerned with such matters as aid administration and must be affected by contemporary problems (e.g., U.S. balance-of-payment problems) above all, politics. Thus Part II takes on a more heterogeneous and less organized form than the other parts of this book. The last part (Pt. III, "Monetary Aspects") is, on the whole, a more technical section on the process, or mechanism, of ICM (topic I b).

Inasmuch as the British experience lasted well over half a century, it takes an economist with historical interest and perspective to grasp this experience in its entirety. The purpose of a historical approach is, first, to provide a factual basis of events in quantitative terms and, second, to provide a theory. Of the two papers in Chapter 1, Professor Matthew Simon's "The Pattern of New British Portfolio Foreign Investment 1865-1914" is entirely factual and presents new data which the author processed with the aid of a computer, on the borrowers' qualifications [i.e., topic I a (iv)]. Thus, the maximum likelihood is that, in those days, a typical borrower was a private party (35 per cent) in a politically independent country (59 per cent) in North America (34 per cent) engaging in investment in social overhead, especially railroads (69 per cent), etc. The author also noted the complex set of fluctuations

which characterized British capital exports in this period, the most notable of which is the long swings.

In the second paper of Chapter 1, "The Historical Record of International Capital Movements to 1913," Professor Brinley Thomas attempts to theorize about the five prominent long swings observable over a century. The thesis is an inverse compensation mechanism in which the slackening of domestic investment activities in Britain was compensated for by investment (accompanied by capital *and* population transfer) in the capital-importing countries. Intuitively, such an analysis of the cause of ICM (topic I a) is appealing. Judging by modern standards, the theory is as yet too impressionistic and the analysis of the empirical evidence on the observed time patterns of terms and trade too primitive. However, the idea is sound and the approach promising.

The contractual content for private ICM [topic II b (i)] depends partly on the ethnical and cultural background of the borrowers. When the government in the borrowing country is primitive, the ICM may take on an imperialistic form of direct investment, namely the Chartered Companies, to exercise the full monopoly power (protected by political power) due to technology and managerial know-how. In the factual account of "The Financial Experience of Lenders and Investors" by Dr. Andrew M. Kamarck (Ch. 2), the experience of the Chartered Companies in Africa for some 60 odd years in the 20th century is reported. The paper does not go into the economics, i.e. the relevancy to economic growth, of these investments. The focal point of analysis seems to be the interests of the chartered companies (which can hardly be identified with the national interests in Africa), which did not fare well, so we are told.

The paper by Professors Saburo Okita and Takeo Miki is a historical view of the "Treatment of Foreign Capital, a Case Study of Japan." The following points have been brought out in clear focus in this Japanese model: (i) given favorable supply conditions, capital inflow may be the result (rather than the cause) of the momentum of industrialization (topic I a); (ii) the quantity of capital is not as important as the *quality* (i.e., the commodity, the service, and the technology imprint) of capital import (topic I c); (iii) the government can play a central and useful role in facilitating and guiding this inflow when it is conscious of the facts that economic growth is the primary objective and that the loans must be repaid. These are sobering lessons for borrowers and lenders in the contemporary world.

The last two papers in Part I (Rosenstein-Rodan, "The Philosophy of International Investment in the Second Half of the Twentieth Century" and Felipe Pazos, "The Role of International Movement of Private Capital in Promoting Development") are misplaced (and somewhat misnamed) as there is very little "historical" about them. Both papers are concerned with topic II b (i) the "contractual content" of private ICM. Pazos' paper sounds like an ABC of the various contractual forms (e.g., "direct investment does not involve any transfer of ownership of the resources utilized"). The short paper of Rosenstein-Rodan tries to compare the suitability of bond vs. equity in the second half of the 20th century of private ICM to underdeveloped countries. It is, perhaps, still too early to talk about this topic.

For reasons mentioned earlier, the contents of the papers in Part II, on contemporary foreign aid experience, are heterogeneous for the reason that they are preoccupied with the evaluation of the imperfections of current institutions of foreign aid from diverse viewpoints. A fair number of these papers (Kafka, Gulhati, Patel) fall into a typical pattern of surveying a collection of loosely classified (but analytically unrelated) issues. The three other papers (Chenery, Onitiri and Haq) are more specific and better organized.

Alexandre Kafka in less than 20 pages examines no less than eight issues (e.g., capital import may discriminate against local entrepreneurship, cause misallocation of investment, cause liquidation difficulties . . .) to caution us against the retrogressive (i.e., antigrowth) effect of ICM. These "suggested possibilities" are not supported by any sort of statistics. Dr. Ravi I. Gulhati surveys three issues—the "need," absorptive capacity and debt servicing capacity—in a more systematic fashion. We are told that, for successful ICM, the importing countries must be aware of their need (which should be a "growth" rather than "humanistic" orientation) and debt-servicing capacity (which must finally rest on intuitive judgment). Under the elusive concept of absorptive capacity, Gulhati provides a useful catalogue of problems at the microscopic level (i.e., preparation, implementation and management of individual projects) and the macroscopic level (i.e., the allocation of investment fund to the totality of all projects according to "incremental capital output ratio," "socially acceptable discount rate," "marginal efficiency of investment," or other criteria). With respect to the latter, Gulhati recognizes that there is a wide gap between economic theories (intuition?) and the feasibility of application to the planning process.

As a practitioner of development planning, Dr. I. G. Patel, "Foreign Capital and Domestic Planning," first complains about the inadequacy of the Harrod-Domar type of planning framework (e.g., the constancy of capital-output ratio) and the omission of reference to absorptive capacity and income distribution. He then criticizes the imperfections of contemporary aid-giving institutions in respect to three issues: uncertainty, terms of repayment, and restrictions on use (i.e., tied aid). The last issue [i.e. topic II b (ii)] was investigated for Pakistan by Dr. Mahbubul Haq "Tied Credits—A Quantitative Analysis" to provide a statistical sense of the problem (e.g., Pakistan should be able to save \$60 million if all \$500 million is untied).

Dr. H. M. A. Onitiri's paper, "Capital Movements and the Volume and Terms of Trade," is directed at the "consequences of ICM" (i.e., topic I b) by examining the impact on volume and terms of trade through basic structural change in the underdeveloped countries precipitated by foreign aid. The evidence derived from post-war experience is probably still too scanty for us to speculate on this problem of long-run significance—beyond the much discussed (but mostly futile) topic of "import substitution" and "export promotion."

It takes an academician-practitioner (Professor Hollis B. Chenery, "Foreign Assistance and Economic Development") to write on the economic and administrative aspects of the foreign aid experience from the viewpoint of the donors. The economic aspect contains a summary, as well as a preview, of the

approach of the Chenery (Bruno-Adelman-Strout) school which centers around the idea of viewing the growth promotion role of foreign aid in removing bottlenecks arising from the saving limit, the import limit (i.e. technological dependence on foreign goods), and the skill limit (i.e. deficiency in investment ability). The basic philosophy of this school is to view economic growth as a mechanical system the operation of which involves the activation and relaxation of certain binding behavioristic conditions and thus yielding different limits at different stages of growth. The administrative aspect contains a cataloguing of certain practical problems of the aid giver (e.g., the criteria governing the allocation of funds to different countries, project vs. program aid [topic II b (ii)] as well as speculations on the design for a more efficient aid-giving institution in the future.

The first paper in Part III (A. J. Brown, "Capital Movements and Inflation") covers three unrelated researchable topics which the author suggested with various degrees of factual backing. The first topic is whether or not price inflation in Latin America has adversely affected the quantity and contractual form of capital inflow. The second topic is on the role of price inflation as a part of the transfer mechanism (topic I b) in the post-World War II setting. The third topic is on the long-run impact on the absolute price level caused by long-run structural change (topic I c). The reviewer feels that the third issue is not a meaningful research topic while the first two issues are dealt with by other papers in Part III.

The first topic is picked up in "Private Capital Movements and Exchange Rates in Developing Countries," by Dr. Rudolf R. Rhomberg, who explains *why* inflation does not deter private equity capital inflow [topic I a (iii)]. If the purchasing power parity theory of exchange rate holds, the effect on anticipated returns in foreign currency of domestic inflation is obviously neutral. When the PPP-theory does not hold, as is the case in the short run, the factor that does deter capital inflow is uncertainty. The second topic is picked up by Professor R. A. Mundell, "International Disequilibrium and Adjustment Process," where in the construction of a model of disequilibrium adjustment incorporating price level, quantity and demand for money, balance of payments, and aggregated demand, Mundell shows how this model can be applied to the transfer problem as well as to a few other problems "in theory." The reviewer suspects that it will be a long time before the underdeveloped countries can develop the kind of economic institutions, with behavioristic sensitivity required by the model, to verify the validity of this model empirically.

The last paper, Javier Marquez's "Financial Integration and the Flow of Resources in Latin America," concentrates on the experiment of institution design for "financial integration" of countries in Latin America in recent years. In the absence of a precise economic definition, financial integration can cover a host of international cooperative enterprises (from Latin American Common Currency, Custom Union, Clearing Union, Bank, down to periodic consultations between finance ministers), from which it is next to impossible to extract a fund of transferable experiences related to economic growth.

With respect to the whole book, the reviewer feels that the message con-

veyed by the Historical Record (Part I) is clear, straightforward, and meaningful. In other parts (II and III) the book is still useful since it aptly conveys the feelings of frustration on the part of economists who attempted to analyze the birth of the new patterns for ICM after the second World War, without the benefit of retrospective detachment.

JOHN C. H. FEI

*Cornell University*

*Trade Liberalization Among Industrial Countries.* By BELA BALASSA. New York: McGraw Hill, 1967. Pp. xvi, 252. \$7.96.

This book is one of eight of the Atlantic Policy Studies series sponsored by the Council on Foreign Relations. Other volumes deal with international financial cooperation, the Atlantic Alliance, aid policies, western policies toward the developing countries, Atlantic trade and agriculture, and U.S. policies toward Eastern Europe. In addition the series includes a set of papers by eight economists from six industrial countries which stresses their countries' interest in trade liberalization; these papers are published in *Studies in Trade Liberalization*, with Balassa editor.

Balassa's book follows the tradition of Council studies; it is comprehensive, articulate, concise, and judicious. Unlike many Council volumes on economic issues, substantial quantitative data are used in an attempt to assess the economic impact of several types of trade arrangements, these alternatives are in Atlantic Free Trade Area, multilateral tariff negotiations under the most-favored-nation rules, a free trade area of industrial countries which excludes the European Economic Community, and an enhanced European Economic Community embracing all of Europe. These alternatives are not exclusive as this may suggest, for new regional groups, once established, might then engage in multilateral tariff negotiations on an MFN basis.

The book was completed in the spring of 1966, nearly a year before an agreement was reached in the Kennedy Round. Balassa's search for alternatives reflects the then-current belief that the negotiations would not succeed. If the agreement is implemented, the post-Kennedy Round tariff structures will be substantially lower, and not by an equal percentage amount, and the potential gains from further reductions on a general or preferential basis substantially smaller.

This book involves empirical applications of customs union theory, together with an assessment of the political implications of some of the choices. Balassa first considers the economic background and the political considerations in the liberalization of trade in the industrial countries. Protectionism in the industrial countries is evaluated, and duties are measured in accordance with the effective tariff concept. One chapter deals with the static effects of trade liberalization, another with the dynamic effects, a third with the impact of trade liberalization on direct foreign investment. Appendices deal with the measurement of effective duties, the measurement of the static effects of trade liberalization, and the policy implications of trade liberalization.

The traditional free trade argument is that any country can enhance

domestic economic welfare by a unilateral reduction and perhaps elimination of its import barriers. The counter-argument is that such actions also would increase the economic welfare abroad, and that domestic economic welfare would be increased even more if the promise to reduce domestic import barriers is used to induce a reciprocal reduction in foreign import barriers. Traditionally, postwar negotiations have been conducted on the basis of reciprocity; each of the major parties to the negotiations has agreed to cut its import barriers by an equivalent amount. Reciprocity has meant equal percentage reductions in duties on the same absolute volume of imports by principal suppliers (other suppliers have benefited, in that they may get the advantage of reduced foreign tariffs without having to reduce their import barriers in exchange). This measurement may facilitate negotiations but it tends to be mechanical; for it is not clear that equal percentage cuts provide the most appropriate way to increase economic welfare by equivalent amounts. Moreover the political benefits from reciprocal reductions may be minimal, and a resultant largely of the altered nature of the community, rather than of a net credit balance in the exchange of concessions.

The assessment of the political implications of alternative U.S. trade policies should reflect cost-benefit analysis; the United States should pursue that trade policy which yields the greatest combined political and economic benefits. Balassa concludes that European integration is desirable, that Canada and the United States should form a free trade area. Then these trading areas, together with Japan, should engage in mutual reduction of duties. In appraising Balassa, the relevant questions are whether the conceptualization of the issue is appropriate, whether the major variables have been included, and whether the economic calculus is sufficiently correct so that there is confidence in the ranking of alternatives.

If trade negotiations are viewed as a vehicle for achievement of a foreign policy objective, some quantitative ranking of the political payoffs attached to different types of trade arrangements is desirable. Then it would be possible to estimate the trade-off between gains in economic welfare and the achievement of political objectives, and to optimize between them. Balassa estimates the gains in economic welfare from a generalized elimination of tariffs, but not for the other trade arrangements. Moreover he focuses on welfare gains from trade in industrial products only, perhaps because the series has a separate volume on trade and agriculture. The costs of adjustments to a reduction in import barriers are ignored, as is the cost of negotiations. Balassa does not estimate foregone gains in economic welfare because a European Trading Bloc and an American Trading Bloc are deemed politically preferable to a non-bloc arrangement. Clearly it is difficult to estimate the gain to U.S. political objectives from integrated Western Europe, and it was not requisite that Balassa supply such data. But without this estimate, acceptance of his preferred alternative is difficult.

In selecting among the choices offered by Balassa, more data and information are needed than he supplies. Clearly not all of the elements in the choice, especially the political aspects, can be quantified. Balassa, in attempting a

quantitative economic utilitarianism for the nation-state, has pointed in a useful direction for policy oriented research.

ROBERT Z. ALIBER

*University of Chicago*

*Les problèmes monétaires internationaux.* By ROBERT MOSSÉ. Paris: Payot. Pp. 318. F19.

The main merit of this book is to integrate in a most lucid fashion economic theory, empirical information, and policy analysis relevant to the topical issue of international monetary reform.

Three introductory chapters summarize the classical theory of international adjustment and apply it to current estimates of the French and American balances of payments. The following four chapters outline the major political and institutional choices open to national leaders in this respect. The last two chapters review the functioning of the Bretton Woods system and the reforms that have been proposed to correct the deficiencies of the gold-exchange standard.

The author strongly attacks the conservative orthodoxy which still inspires at times some of his colleagues and of national leaders, in France and elsewhere. I very much agree with his criticism of policies derived from a narrow consideration of arbitrarily defined "overall balance" deficits, and with his integration of such information into a broader framework of national accounts. He gives priority to economic growth over balance of payments equilibrium, and welcomes foreign "deficits" compensated by an expansion of long-term assets and investments abroad, or even at home. In doing so, however, he tends to understate (1) the liquidity problem which may, willy-nilly, put an end to a country's persistent reserve losses, and (2) the international incompatibility of such policies if simultaneously pursued by many countries.

Mr. Mossé tries to elude some of these problems through more "elastic" policies regarding exchange rates (i.e., the adoption of flexible rates) and exchange control. This might help solve the first, but not the second, of the two difficulties raised above, and would not, in any case, guarantee indefinite access to the foreign borrowings needed to finance continuing deficits.

The author's arguments and conclusions regarding the future role of gold in the international monetary system and the functioning of the gold-exchange standard and the IMF cover soberly, lucidly, and judiciously a broad area less fully and fairly explored by the proponents of conflicting reform plans. I find him, myself, excessively generous in his judgments concerning the gold-exchange standard and the achievements of the International Monetary Fund. I welcome his arguments for an international demonetization of gold, but wish he had stressed, more than he does, that this may be politically unfeasible—or even disastrous—as long as the only alternative to gold remains the accumulation of so-called key currencies, i.e., in practice the financing of U.S. or U.K. policies on which other countries may not have been consulted and with which they may forcefully disagree. (Am I, however, an unbiased observer on a problem in which I have long been so deeply involved in my writings?)

Space does not permit me to dwell on minor points whose treatment could be improved, such as the summary of purchasing power parity theory (p. 38), the inclusion of *all* unilateral transfers within the balance of payments current account, and the messy presentation of some statistical tables (p. 62, for instance).

In conclusion, this is a lucid and useful introduction to an important and topical aspect of international economies, and an intelligent plea for a broader approach to policy action than is often found in such texts. I particularly welcome the author's plea for progressive, but radical, reforms of the IMF and for the reintegration of Eastern Europe in the international monetary community.

ROBERT TRIFFIN

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*A Primer on International Trade.* By JAN PEN. New York: Random House, 1967. Pp. x, 146. \$1.95.

"The dispute between free traders and protectionists is still going on. The advocates of free trade are winning every battle—in the textbooks" (p. 104). Professor Pen did not write a textbook, but he certainly won his battle against short-sighted protectionism in today's world. This is not to say that Pen's little book concentrates on the issue of free trade *versus* protection only; the title of the book is fully justified by its contents. On the other hand, in presenting the fundamentals of international trade theory and policy the author does not fail to stress time and again the advantages of an international division of labor and of an international exchange of goods and services—and very rightly so, in this reviewer's opinion.

Part I deals with the basic principles of international trade theory, i.e., mainly with the theory of comparative costs. Part II is devoted to the balance of payments and the problems of equilibrium in foreign trade and payments; it includes a useful chapter on the essentials of Keynesian analysis regarding balance of payments problems, and it ends with a discussion of the forces that are continually changing the pattern of world trade. Part III discusses autarky and protection, trade expansion, and regional association and integration. Also, a few pages are devoted to trade with centrally planned economies and to the trade problems of developing countries.

Pen is an experienced writer on economic topics, and has a particular talent for explaining problems of modern economics to readers not trained in that profession. He again displays this skill in the book under review. It is almost everywhere admirably clear, and entertaining at the same time. It makes therefore very pleasant reading, and one feels—or this reviewer felt, at least—that Pen must have enjoyed writing it. Is it perhaps due to a desire to maintain the pleasant atmosphere of the book that the grim reality of the structural imbalance of the trade of the poor countries, encompassing two-thirds of mankind, is given so little attention?

As Pen's book is an introductory text, of limited length, on a subject well studied by economists for more than a century, it is not surprising that the



book does not raise theoretically controversial issues. Only a few comments seem necessary. (1) On page 19 the author discusses the objection of an inhabitant of a poor nation to the theory of comparative advantage. "My country has no comparative advantages," this man says, "we are too expensive all along the line." Pen answers that the rate of exchange should be lowered so that "the prospects for exports might become brighter, and it might be easier to find the branches of industry in which the country has a comparative (not an absolute) advantage." This is certainly true, except that vis-à-vis the potential trade partners of this country (the importers mentioned two pages earlier) the comparative advantage should effectively be turned into an absolute advantage if trade is to take place. (2) It is not true that "foreign aid . . . rests disproportionately on American shoulders" (p. 85). See, for example, the OECD's *Reviews of Development Assistance Efforts and Policies* and the various sharing-of-the-aid-burden proposals. (3) The author points out in a note on page 95, that the U.S. tariff on industrial goods is higher than its nominal level indicates, because of the U.S. Selling Price System (which is not mentioned by name). He writes: "The duties that the importer pays are not based upon the price of the comparable domestic product." Obviously the word "not" should be deleted, or the sentence rephrased. (4) There is an inaccuracy on page 127; Singapore was part of Malaysia only till August 1965, and Brunei never was.

Pen's book deserves to be widely read. Undergraduates may benefit greatly from it, primarily because of its clarity but also because of its "programmed" setup ("if you don't understand this point completely, go back to chapter so-and-so"). It may also be recommended to the nonacademic reader, however; one would hope that in particular politicians who have to decide on matters of foreign trade policy would find the time to spend a few hours with this book. The gains that this investment of time could yield to the world at large are quite considerable.

HANS LINNEMANN

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*International Economics and Business: Selected Readings.* Edited by WALTER KRAUSE AND F. JOHN MATHIS. Boston: Houghton Mifflin, 1968. Pp. xiii, 490. \$5.25.

This book offers a fresh approach to "international" subject matter: it successfully brings together the substance of traditional international economics and the core materials of the growing field of international business. The unifying theme is that of the presence in the international economy of a dual decision-making authority, emanating from government and business. Government actions (of central concern in international economics) affect the international environment, but so, also, do private actions (upon which attention has centered in international business). Indeed, the two sets of actions are very much interdependent, a fundamental point developed throughout this volume.

The presentation consists of selections drawn from diverse sources, coupled

with original materials. More than 60 major selections are included. The choices reflect imagination and good judgment. The substantive content is enormous, well-balanced, and relevant to the present; skillful excerpting adds to overall solidity. Likewise, the representation of authors is impressive—there are contributions by over 60 authors, providing different points of view as well as the basics on particular topics. The editors have interspersed editorial commentary which effectively relates the selections to one another and provides overall focus to the volume.

The headings to the six major divisions reveal the gist of the story being told. Part One—The International Economy—provides basic background on the international economy: its nature, participants, and performance. Part Two—The United States in The International Economy—examines the international economy from the specific standpoint of the United States. Part Three—International Economic Policy of the United States—surveys the key components of this country's policy toward the international economy. The approach in all these sections emphasizes the side-by-side presence of government and business. With Part Four—United States Business in the International Economy—the role of American business in the international economy is approached directly. And in Part Five—Policy Issues on International Business—attention is given to a number of important problem areas of international business and the government-business association. Finally, Part Six—Prospects for the Future—offers speculation about what is to come; the trends of trade and investment, etc.

The book seems well suited for use in a number of courses, spanning international economics, international business, and economic development. It should appeal especially to instructors of international economics who wish to reinforce other reading with something more on "private sector aspects," to instructors of international business who seek to treat business within the context of the overall international environment, and to instructors of economic development who regard business as deserving of more attention as a lever of developmental promotion. Aside from the classroom, the quality of the selections and the topicality of their orientation should assure the volume of considerable use as a ready reference source for some time.

At the risk of quibbling, this reviewer would have liked the inclusion of a selective bibliography to steer the reader onto further materials. Also, inclusion of two further selections expressly devoted to Japan and Canada, both important trading partners of the United States, might have been helpful. Such omissions detract little, however, from what must be considered a first-rate work. The volume's integrated approach clearly represents a major step forward in the treatment of "international" subject matter.

ROBERT A. FLAMMANG

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**Business Organization; Managerial Economics;  
Marketing; Accounting**

*Mathematical Reasoning in Economics and Management Science.* By JOHN C. G. BOOT. Englewood Cliffs, N.J.: Prentice-Hall, 1967. Pp. xii, 178. \$7.95.

This book consists of twelve chapters, of which four are primarily mathematical, three are concerned with decision theory, and the remaining five with models used in management science and economics. The mathematical chapters are concerned with characteristic-value problems, difference equations, probability problems, and Markov chains; the decision theory topics are on decision criteria, game theory, and strategies, while the remaining chapters present elementary models in the areas of dynamic programming, inventory management, input-output, growth, and sensitivity analysis. "The choice of topics was guided by the fact that one or more of these topics is always neglected in structured courses." This set of twelve chapters itself neglects a number of topics usually found in courses in management science, notably linear programming, simulation, and equipment replacement theory. The unusual nature of the topics covered is that topics in both economics and management science are included in the same volume whereas most texts are primarily focussed on one or the other of these areas. A combination of two typical texts in the two areas would provide a much wider selection. Nevertheless, it is the author's right to select whatever topics he wishes and Boot's choices are interesting enough. The book's short length precludes a thorough treatment of the topics considered. In this respect it is not adequate as a text. The reader will acquire very little skill in model construction. Its function rather is presumably to acquaint readers previously not exposed to literature concerning mathematical models and techniques (other than calculus, matrix algebra, and rudimentary probability theory assumed) with an overview of several applications of these techniques. Very little of the material trains the reader to make such applications on his own or provides him with a thorough understanding of the techniques employed. For example, the concept of "discounting" is explained by a single short postscript (p. 110) and such basic fundamentals as the fact that maximizing the "internal rate of return" and "discounted cash flow" do not in general result in the same decisions. "Barring freakish cases this procedure works, and it is theoretically widely acclaimed" (p. 132). The probability chapter consists of a highly specialized set of problems and does not develop any ability on the part of the readers to solve similar problems. The mathematical motivation is not revealed to the reader. A more detailed criticism is that an identical economic lot size model is developed two times, in adjacent chapters! There are arithmetical errors in at least two of the thirty-five examples.

The book is written in a style that holds the reader's interest. It can be read usefully and enjoyably as a collection of assorted gadgets. For more than a dilettante's knowledge, however, a different sort of text must be recommended.

T. M. WHITIN

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### Industrial Organization; Government and Business; Industry Studies

*The Structure of the Defense Market, 1955-1964.* By WILLIAM L. BALDWIN. Durham: Duke University Press, 1967. Pp. viii, 249. \$8.00.

Professor Baldwin analyzes the structure of the defense market in a decade of Cold War, characterized by neither escalation nor disarmament. The defense market had virtually completed its adjustment to the end of hostilities in Korea by fiscal year 1955, and the Vietnam buildup did not result in significant demands for U.S. resources until the second half of the fiscal year 1965. The intervening decade, therefore, was a period in which the structure of the market could evolve and respond in a fairly orderly manner to the demands of national defense in a period of rapid technological change, but without rapid changes in the level of such demands.

The author has developed and analyzed a large and extremely comprehensive array of pertinent data on the structure of the military market in the United States. The result is not light reading but the reader interested in this important, but still relatively neglected, area of interaction between government and business will find much that is worthwhile.

The following are among the key findings which this reviewer extracted from the wealth of data and detailed analysis contained in the study:

1. Due to the impact of "space age" technology, the concentration of total defense contracts increased during the years 1955-1964 from World War II and Korean levels. The top 50 firms accounted for 66 per cent of military prime contract awards during the fiscal years 1963-64, compared to 56 per cent during Korea and 58 per cent in World War II (p. 9).

2. Impressions of volatility in the composition of the major defense contractors gained from merely looking at annual exits from the highly publicized list of the top 100 "are grossly exaggerated" (p. 17). Through painstaking research, Baldwin shows that many of the "drop-outs" are due to mergers and the special case of short-term joint ventures by construction companies. In light of the changing composition of defense spending, the relative stability of the major defense firms is considered to be "remarkable."

3. On the basis of personal correspondence with the firms involved and other primary sources, Baldwin develops a picture of the dependence of the major government contractors on defense business. The "typical" large contractor received about half of its sales from military or government business (49 per cent in 1957 and 51 per cent in 1962) (p. 74).

4. Baldwin suggests the possibility that the overall low elasticity of military demand for goods and services can be consistent with very high elasticities of demand for specific items (p. 81). If there are several products capable of performing closely similar functions, relative prices may be important determinants of the quantity of each purchased, even though the buyer is willing to pay almost any price to have that general class of functions performed. He also notes that the McNamara efforts to increase competition at the early development stages have done little to increase demand elasticities at the later and more costly stages of a weapon system.

5. Baldwin attributes the substantial barriers to entry into the defense market more to highly specialized and technologically advanced requirements of the military customer than to government procurement policies themselves (p. 167). However, he does not pay sufficient attention to the entry-discouraging effects of government-owned plant and equipment provided gratuitously to the major long-term contractors. In order to reduce the high degree of stability among defense contractors, Baldwin urges attention to barriers to exit. He considers alternative types of government assistance to defense contractors who attempt to utilize their capabilities in commercial markets. In view of the consistently poor results that these diversification efforts have yielded in the past and the extreme reluctance of the company managements to invest substantial amounts of their own funds in these ventures, this approach would seem to offer little encouragement.

6. An interesting array of profit ratios is developed for the major defense firms. Baldwin appears to conclude that the most important feature of these data is "the increase in rates of return on sales as specialization in the defense market declines" (p. 190). His data also reveal, however, that the rates of return on equity were generally higher for firms with larger percentages of sales in the defense market than they were for those with smaller percentages. This is a point usually overlooked, or at least played down, by many in the defense companies and in the military establishment. When data for companies selling primarily to the military are compared with results for commercially oriented corporations, we find that the lower profit margins on military work are more than offset by the large amounts of government supplied capital. Thus, rates of return on stockholder's investment are substantially higher for the defense contractors.

As Baldwin's findings and conclusions relate to a period of cold war, developments in the military market since the Vietnam buildup have changed some of the patterns. For example, the entrenched position of the large aerospace and electronics companies has been weakened somewhat because military demand has shifted from large bomber and missile systems to conventional war ordnance; the latter is supplied in good measure by medium-size mechanical equipment producers. Although much of the specific data and even findings developed by Baldwin may mainly become of historical interest, perhaps the major long-term value of his work is to demonstrate that the defense market is amenable to the traditional analytical tools of industrial organization and thus to encourage additional work in this area.

MURRAY L. WEIDENBAUM

*Washington University*

*Trends in the World Aluminum Industry.* By STERLING BRUBAKER. Baltimore: Johns Hopkins Press, for Resources For The Future, 1967. Pp. xiv, 260. \$6.95.

Mr. Brubaker's study is more specific than the title would indicate: he is aiming at the future locational pattern of aluminum production and primary smelting. After a sketch of past trends and a quick but useful panoramic survey, he considers the future demand for aluminum, with particular reference

to competition from steel, copper, and less close substitutes. This serves to set the stage for a chapter on basic technology, and one on the size structure and competitive practices of the international industry. With the growth of the industry and the number of firms in it, less public benevolence toward cartels, and better awareness of the competition from other metals and secondary aluminum, "the major international firms appear to compete strongly with each other." Nevertheless, this competition is limited by the integration forward, or by construction of primary facilities with government protection, which has about the same effect in foreclosing the custom of fabricators who would otherwise be free to choose among the firms. Government policy toward international trade in ingot aluminum and a restricted range of products is again a mixed picture, but on the whole the downgrading of aluminum as a very scarce armament metal, plus the general tendency to liberalize trade, have both fostered somewhat greater competition. Hence prices are a better indicator today of real social cost.

There follows a very useful chapter, which must have been difficult to write, on the cost structure of the industry and on the prospects of improved technology. The strategic factor is considered to be low-cost electric power, and the writer considers carefully the prospects of lower costs from coal, gas, oil, and above all nuclear power. Here the author has a major problem, which probably could not be solved in a brief space. For every supplying industry, he needs essentially the same kind of inquiry that he has made for aluminum, covering demand, cost, and the degree of competition, in order to be able to guess at what price it will be forthcoming. Where this reviewer would part company would be in his seeking the most reasonable single-valued estimates. Sources of error are so numerous, especially of change in technology or market structure, that substantial error is inevitable, and must be hedged against by indicating the range of variation and the difference it would make for his ultimate conclusions. This indeed is what he did in considering the relation between fuel costs and thermal efficiency (p. 185) and one wishes this had been done throughout. Basing himself on current costs of oil, he concludes that very little new smelting capacity is to be expected outside the United States and Australia. But if real costs of oil are very much lower, and would be available "should national policy permit its entry" this conclusion would have to be substantially modified. Will policy change? He owes us the question, though not the answer. Again, prices quoted for nuclear power stations (footnote, p. 197) are far below current: the price for one thousand megawatt plants is about fifty per cent higher now.

The author expects that future plants will not be located more often in Africa, South America, or South East Asia than they have previously. The underdeveloped countries will be handicapped in the future as in the past by high costs of power and capital while labor costs are of minor importance. One will undoubtedly find some exceptions, but they seem to be few. This supposes that the current climate of noninterference or less interference will continue and that location will be determined largely by comparative costs as in the recent past. The desire on the part of developing countries to claim any economic rent arising through the exploitation of their resources is entirely un-

derstandable. However, it is doubtful that there is much rent to be claimed in the aluminum industry. Bauxite supplies are too plentiful and alumina production "provides little opportunity for economic rent."

Brubaker has had to cut across a wide range of subjects, and has done an exemplary job of analyzing an important commodity. The book deserves an audience not only for its subject but for its method: look to demand, supply, and market structure.

M. A. ADELMAN

*Massachusetts Institute of Technology*

*The Economic Impact of TVA.* Edited by JOHN R. MOORE. Knoxville: The University of Tennessee Press, 1967. Pp. xv, 160. \$4.95.

The eight essays in this volume incorporate principally a series of lectures presented in 1964 on the thirtieth anniversary of TVA. One neither expects nor finds much coordination of subject matter. Stefan Robock confesses a professional embarrassment over the lack of a single scholarly work evaluating TVA as a means of social and economic development, and suggests a possible approach. The volume will not leave him or anyone else much better off. None of the authors had space enough to get off the ground, although many comments are not without meaning or interest. Bruce C. Netschert protests against exaggerating the importance of cheap energy in economic development. John Oliver thinks TVA is well worth studying by underdeveloped countries, but as Robock's comment implies, it is not clear what was being accomplished in the one place nor, therefore, whether it promises well or ill for the other. Joseph L. Fisher thinks TVA's most important contribution is the very idea of regional development, with a specialized agency of national government "leading and encouraging numerous public and private agencies within the region to improve the lot of the people living there." Apparently no more satisfied than Robock with the current state of cost-benefit analysis, he is hopeful about recent advances in analytical and statistical techniques. The place of TVA in history is secure; he asks what of its future.

Norman Wengert writes an interesting short political history of TVA, which is discouraging in showing that ideological static about "creeping socialism" is still being taken seriously in recent years. But discussion of costs and benefits of hydroelectric or thermal generation is strikingly absent from the book.

Ronald H. Wolf writes on TVA's connection with the notorious electrical equipment price-fixing cases. The conclusion I would draw from his essay, contrary to his own, is that TVA had virtually nothing to do with the exposure of the conspiracy. It would have been poetic justice if they had, since TVA only began publicizing identical bids as a counter-measure to the attacks made on them for buying foreign electrical equipment. Gilbert Banner tries to make a critical appraisal of TVA and supplies at least a useful introduction to such a study. Finally the board chairman of TVA writes the expected upbeat ending.

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**Land Economics; Agricultural Economics;  
Economic Geography; Housing**

*Controlling Pollution.* Edited by MARSHALL I. GOLDMAN. Englewood Cliffs, N.J.: Prentice-Hall, 1967. Pp. xiii, 175. \$4.95; paper, \$1.95.

*Economic Costs of Air Pollution.* By RONALD G. RIDKER. New York: Frederick A. Praeger, 1967. Pp. xii, 214. \$13.50.

*The Pesticide Problem: An Economic Approach to Public Policy.* By J. C. HEADLEY AND J. N. LEWIS. Baltimore: The Johns Hopkins Press, for Resources for the Future, 1967. Pp. xvii, 141. \$3.50.

The essays in *Controlling Pollution* are grouped into four major parts plus an introductory article by Marshall Goldman and a statement on pollution by the Council of Economic Advisers. Part One titled "The Nature of the Problem" contains three essays. In the first, Gladwin Hill indicates why he doesn't like water pollution; and, in the second, C. W. Griffin, Jr., complains about air pollution. The third essay, written by Goldman and Robert Shoop, is an interesting summary of the technology of measuring and treating various types of pollution. Articles worth mentioning in Part Two, entitled "Economic Analysis," are by Milton Friedman on the role of government; Edwin Mills on the use of economic incentives in controlling pollution; and J. E. Hazelton on pollution controls in the New England area. Part Three of the book contains five papers, each describing actions taken to "solve" a particular pollution problem. The best is Allen Kneese's description of water control in the Ruhr area. Part Four of the book contains three articles that appeared in Soviet newspapers and a section of a speech by Mikhail Sholokov. Each is a plea for greater pollution control within the Soviet Union.

The purpose of many of the articles appears to be that of motivating the reader to "do something" about pollution. With the exception of Kneese's article none of the papers was intended for publication in a scholarly journal. Consequently the book will probably be of little interest to the professional economist. Nevertheless, some of the papers provide interesting reading primarily because of the examples and observations on institutional matters, and because some of the many broad generalizations seem worthy of careful investigation.

The objectives of Headley and Lewis, in *The Pesticide Problem: An Economic Approach to Public Policy*, are "to develop a clearer understanding of the issues for public policy in the pesticide problem, to suggest an approach to policy formulation based on economic analysis, to review what is known about the technical relationships between pesticides and environmental quality and to propose research approaches that will provide guidance for future pest control policy."

The first of the eight chapters contains a discussion of the various types of pesticides as well as the aggregate use of materials and the various areas where they are used. The first few pages of the second chapter say that marginal cost should equal marginal benefit. The remainder of the chapter is a summary of methods for controlling pests other than by the use of chemicals.



The third chapter contains a short description of the methods of cost-benefit analysis and some rather oversimplified consumer surplus arguments on the benefits from the introduction of pesticides.

The fourth chapter pertains to the impact of pesticides on agricultural productivity and organization. The data, drawn from U.S. Senate Hearings, indicate the possible magnitude of increased output of various crops due to the introduction of insecticides and herbicides. They also briefly summarize the general directions of research pertaining to the technical relationship between pesticide residues and soil properties.

Chapters 5 and 6 are devoted to the effects of pesticides on human health and the evaluation of those effects. The effects of pesticides on humans are classified as those due to the reduction of diseases and those due to toxic effects of the chemicals themselves. Evidently, pesticides present the greatest problem as an occupational hazard. But here, as in the case with accidental poisoning and the existence of toxic residues in foods, it appears that the problem is not necessarily one of the lack of knowledge about technical relationships but rather carelessness in the use of these chemicals and disregard for instructions. The authors really made no attempt (ten pages) to place a value on the effects or even to outline the literature on the subject.

The authors have great difficulty indicating an economic approach to the relationship between pesticide use and the effects on fish and wildlife. Little is known about the direct effects of different pesticides on different animals and the food-chain relationships are highly complex. Furthermore, even if the technical relationships were understood, there are problems in integrating them into welfare economics and cost-benefit analysis.

Headley and Lewis succeeded in doing what they intended to do. Even though there are many problems with their applications of welfare economics and most of their "conclusions" are really at the conjecture stage, they have done a good job on much of the preliminary research necessary for economic studies relating to pesticides.

Ridker's book, *Economic Costs of Air Pollution*, is a useful addition to both the cost-benefit literature and the air pollution literature. The book is very easy to read since Ridker has carefully outlined his procedures and results. Surprisingly enough, the best parts of the study are not numbers or functions representing the cost of air pollution, but the systematic failures of reasonable procedures and imaginative tests to yield some measure of the cost of air pollution. Perhaps this work will serve to decrease the propaganda and oversimplification which shroud the topic.

Ridker uses three different approaches to the measurement of air pollution costs. The first is to determine the functional relationships between a measure of "pollution" (say annual geometric mean sulfation rate) and physical damage (say metal corrosion) to some object. A value is then placed on the physical damage. This approach is used to measure the cost of disease associated with air pollution (Ch. 3). In this case, the "damage" would be in terms of premature death, premature burial, treatment, and absenteeism. Income foregone and value of treatment are the associated costs. Ridker first attempts to measure the cost of six diseases (cancer of the respiratory system, pneumonia,

etc.) and then to determine the number of cases due to pollution. He has trouble obtaining data on the cost of diseases but the real trouble is relating them to pollution. Using 56 metropolitan areas, several different measures of pollution, and several demographic variables, he failed to find a relationship between pollution and mortality rates. Absentee rates due to illness for a St. Louis firm were not explained by the pollution levels at the employees' places of residence. A study of absenteeism at St. Louis elementary schools gave the same results. The only measure that could be found that might implicate air pollution was the difference between urban and rural death rates.

The second strategy used to measure the cost of air pollution is to measure the costs incurred by individuals in their attempts to reduce the effects of air pollution. With soiling and materials damage in mind, Ridker attempts to get the cost by comparing between cities the differences in laundry and dry cleaning receipts, cleaning costs of businesses, and receipts of a contract cleaning firm. Within a particular city with pollution levels differing between areas, he compares sales of cleaning supplies and business maintenance procedures for several different firms. Finally, a questionnaire was designed to determine differences in household cleaning activities. The results were uniformly negative. The same approach is used again (Ch. 5) in a particularly interesting attempt to measure the cost of an isolated pollution episode by the use of questionnaires.

The third strategy used to measure costs is what Ridker calls "market effects" which in principle would be the measurement of consumers' plus producers' surpluses in affected markets. Since air pollution is specific to locations, and locations are fixed in supply, Ridker attempts to measure the cost of pollution by measuring differences in property values. There can be problems in connecting this measure of "cost" to the measures of "cost" needed to solve the externality problem. Assuming individuals in the absence of pollution are indifferent between locations, this index will give the correct results. But, slight modifications in this assumption could cause the index either to overestimate or to underestimate the proper "costs." In any case, Ridker (using cross-section data in Chapter 6) does a pretty good job of establishing a functional relationship between a pollution index and property values. An imaginative time series study in Chapter 7 yields less satisfactory results.

In both Headley and Lewis, and Ridker, there is a major preoccupation with the idea of "internalizing costs" as opposed to the "exploitation of gains from exchange." This causes a little trouble in two different ways. The first problem is that both studies proceed on the presumption that there exists a "social cost" function, say  $S(x)$ , that needs to be added to the "private cost" function and thus "internalized" into the firm's decision process. The trouble is that except in special cases, such as separable cost functions, there are actually joint costs attended by the problems of allocating them. The magnitude of external costs depends not only on the activities of the pollutor but also on the activities of the receptor. The only relevant number is marginal external cost *at the optimum*.

The best example is found in Ridker's second method of measuring pollution costs. Suppose the production function for firm 1 is given by  $X_1 = f^1(Y_1, D)$ .

where  $X_1$  is output,  $Y_1$  is a factor, and  $D = D(Y_2, X_2)$  is a damaging element, say corrosion, which depends upon  $Y_2$ , the frequency of painting, and  $X_2$  the output of firm 2. Let  $Y_2^* = h(X_2)$  be firm 1's profit maximizing level of  $Y_2$  for each  $X_2$  and assume  $h(0) = 0$ . Ridker's procedure would establish the social cost of  $X_2$  to be  $S(X_2) = P_{Y_2} h(X_2)$ . But if  $S(X_2)$  were made "internal" to firm 2's decisions the result would be, in general, nonoptimal.

The second problem is that this view attracts attention to the problem of measuring costs to the exclusion of other considerations. Since Headley and Lewis are interested in formulating an economic approach to pesticide problems perhaps they could have at least given some attention to property rights, liabilities and court proceedings and other exchange mechanisms. Furthermore, even if the costs of pollution were calculated and an optimum achieved in a manner envisioned by Headley and Lewis, and Ridker, there would still be a pollution problem. Unless the receptor of pollution pays for reduced pollution (either by payment or bribe foregone) it is still in his interest to encourage a reduction in pollution levels.

CHARLES R. PLOTT

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✓ *Eco* *The Theory of Peasant Economy*. By A. V. CHAYANOV. Edited by Daniel Thorner, Basile Kerblay and R. E. F. Smith for The American Economic Association Translation Series. Homewood, Ill.: Richard D. Irwin, 1966. Pp. lxxv, 317. \$8.00.

This is an English translation of two of Chayanov's works: the long *Peasant Farm Organization* (*Organizatsiya krest'yanskogo khozyaystva*), originally published in Moscow in 1925, and the brief "On the Theory of Non-Capitalist Economic Systems" ("Zur Frage einer Theorie der nichtkapitalistischen Wirtschaftssysteme") which appeared in the *Archiv für Sozialwissenschaft und Sozialpolitik* in 1924. In addition, the editors contributed two essays on Chayanov's life and works, and a bibliography. The latter includes a list of libraries where his works can be found and even the respective call numbers. The editors have certainly performed their formal duties.

We are told in the Preface that "Probably the most sophisticated and best documented studies of the theory and problems of peasant economy in the half-century from 1880 to 1930 were written by Russians," and that Chayanov's *Peasant Farm Organization* appears as "The masterpiece of this theoretical literature . . ." (p. v). Since economic development is a popular subject these days, a real and a novel (for a Western reader) insight into peasant problems should be of the greatest interest.

The book abounds in statistical tables and observations on the economy of Russian peasants; I shall comment on these below. Both Chayanov and his editors, however, regarded his theory as the most significant part of his work. Indeed, Chayanov compared his contribution with Lobachevsky's non-Euclidian geometry (p. 226).

Chayanov constructed his theory because of the supposed failure of traditional theory to explain certain aspects of peasant behavior, such as variations in the intensity of land cultivation, willingness to pay rent or to buy land at

prices higher than its net or capitalized income, to borrow money at very high rates of interest, etc.; the peasant was able to survive a fall in agricultural prices which was ruinous to a capitalist farmer; as a matter of fact, the peasant worked ever harder. There were many other peculiarities in peasant behavior as well.

The traditional theory was inapplicable to the peasants because it was solely concerned with capitalist enterprises which hired workers and maximized profits. A peasant family farm, on the other hand, employed its members' labor; it paid no wages, no rent for its own land, and no interest on its own capital; hence it had no profit to maximize:

The economic theory of modern capitalist society is a complicated system of economic categories inseparably connected with one another—price, capital, wages, interest, rent, which determine one another and are functionally interdependent. If one brick drops out of this system, the whole building collapses. In the absence of any one of these economic categories, all the others lose their specific character and conceptual content, and cannot even be defined quantitatively (pp. 3–4).

One could remind Chayanov that, strictly speaking, a capitalist maximizes not his profit but his utility: by sitting up nights and devising new schemes he might raise his profit. But let us not quibble about details, and ask instead the basic question: what does the peasant maximize? It turns out that a peasant family, being both a production and a consumption unit, maximizes its utility by equating its marginal disutility ("drudgery," in the English translation) of labor with its marginal utility of income. It comes as a surprise to a Western reader that the behavior of Russian peasants remains unexplained by the traditional economic theory *because* the peasants behave exactly as the theory prescribes!

Two facts about Russian peasants are relevant here: first, in large areas of central and southern European Russia the land/labor ratio on peasant farms was generally low; second, land, labor and capital were distributed among peasant households in a nonoptimal manner. Some had particularly little land relative to their labor power; others had much more. The combination of these two facts goes far to explain most of the peculiarities of peasant behavior observed by Chayanov (and others). A peasant mutual rental agency for the hire of labor, land, and capital would have eliminated many of these peculiarities, but Chayanov specifically excluded the hiring of labor because less than ten per cent of households engaged in it.

Basic to the peasant's behavior is the presence or absence of nonagricultural opportunities for his labor. If they are absent, he has to continue cultivating his crops almost irrespective of the terms of trade, and he may be willing to pay high rents or prices for additional land. If other opportunities are present and if they are good, he'll behave more and more like a capitalist farmer. Chayanov had many interesting things to say about peasant crafts and trades, but he failed to incorporate the concept of opportunity cost into his theory. At times his reasoning was a bit strange; thus in showing how a fall in agricultural prices ruins a capitalist farmer (but not a peasant), he assumed a constant wage (pp. 88–89). And when he came to one of the most

important questions in the book—do Russian peasants really have negatively sloping supply curves of labor—his proof consisted of two tiny tables (one from Switzerland, of all places, and the other from a Russian province), and a number of theoretical diagrams which happen to be wrong (pp. 80–84).

I would say that Chayanov's main talent lay not in creating new economic theories, but in observing Russian peasants. This he did with a keen eye and much common sense. For instance, his treatment of the peasant family as a dynamic institution which changes its size and structure over time, is excellent; these changes seem to account for a good part of the differences in income and wealth among peasants, rather than the process of social differentiation stressed by Lenin. There are also useful suggestions regarding the future development of Russian peasant agriculture (he did not anticipate the forced collectivization soon to come): he advocated not a horizontal integration (merger) of peasant farms but a vertical one, that is, the gradual transfer of more and more peasant activities to cooperatives. The reader will also find interesting materials about the disposition of peasants' incomes; comments about the negative correlation between food prices and wages in Russia, and many others.

The book contains much statistical data, but unfortunately they are presented very sloppily. Many tables have no titles (though these can be usually deduced from the text); more important—most of them have no dates, and it is not clear what period they refer to. Figures for several areas are presented without any indication whether these areas are typical, and if so, of what part of the country and when. Differences in the variables are regarded as being significant without any statistical tests. And so are simple correlation coefficients of .61, .41 and even of .24 (pp. 64, 105)—the most sophisticated statistical technique used in the book. Chayanov either could not use multiple regression analysis (which his data often beg for) or chose not to. And the book is full of repetitions.

Perhaps the most important service performed by this translation is to remind us about the existence of vast quantities of statistical data about Russian prerevolutionary peasants, data collected with much labor (and love) by *zemstvo* statisticians and waiting to be studied by properly trained investigators.

EVSEY D. DOMAR

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*The Columbia River Treaty: The Economics of an International River Basin Development.* By JOHN V. KRUTILLA. Baltimore: The Johns Hopkins Press, for Resources for the Future, 1967. Pp. xv, 211. \$7.50.

John Krutilla has added another to his long list of contributions to the literature on public development and management of natural resources. While the detailed technical discussion will be of absorbing interest only to the true water buff, Krutilla also provides a remarkably lucid case study of the economics of international river basin development. In the process, he has demonstrated, with sobering effect, that the book had to be written as an exercise in political economy.

Part I sets forth the two basic economic questions to be resolved as Canadian and American negotiators set out to translate fifteen years of discussion into action. First, it was necessary to identify the elements of the most efficient system for development of the upper Columbia. Given this system for maximizing the joint gains for mutual sharing, it was essential that the participating nations conduct a similarly thorough analysis of all alternative systems based on the domestic resources available to each. The difference between the sum of the individually achieved net benefits and those from the optimal joint system provides a measure of the total potential gains, and defines a bargaining range within which both parties could realize positions superior to those that could be achieved by independent action.

Part II indicates how these basically sound principles were altered in filtering through the political constraints that prevailed in each country. On the Canadian side the initial unwillingness to accept American financing of projects to be built in Canada or to export power surplus to immediate Canadian needs, and the complex relations between the Province of British Columbia and the federal government had to be considered. On the American side, the usual alliance between the Corps of Engineers, which wanted to build the Libby project in Montana, and the local interests which would benefit thereby, dictated the construction of that project regardless of efficiency considerations. In addition, the so-called "Partnership Policy" had resulted in virtual withdrawal of the federal government from major hydroelectric projects in the western United States from 1953 to 1961. The resulting hiatus left the United States seriously deficient in the storage capacity required for flood control and to firm up power production on the Columbia during seasonal periods of reduced flow.

The result of the filtering process was a set of principles, developed by an International Joint Committee to guide the negotiators, which juggled basic efficiency criteria just enough to mean all things to all men. It is hardly surprising, therefore, that analysis of the negotiations and an economic evaluation of the resulting treaty project system in Part III lead Krutilla to the conclusion that it fell far short of realizing its full potential. The projects chosen were not optimal from the standpoint of the river system as a whole. The procedures adopted for division of benefits committed the United States to a program that is almost certainly more costly than a properly designed system based entirely on domestic projects. The failure to take advantage of new alternatives that opened up between the initial agreements of 1961 and the final settlement in 1964—in particular, the possibility of interties between the Columbia River and Peace River systems, and between the Northwest and Southwest power systems—cost both countries heavily in further economies foregone.

In short, by the time the sound economic principles outlined by Krutilla had run the gauntlet of Canadian and American politics, the hostages to fortune and dogmatic procedures of the Corps of Engineers, and the inevitable limitations of intercommunication among economists, engineers, and negotiators, it is hardly surprising that they emerged a little tattered. Even under Krutilla's properly conservative procedure of reviewing alternatives only in

terms of the same information available to the negotiators at each stage, it is apparent that neither system efficiency nor the relative position of the United States fared as well as could be reasonably expected. Whether an optimal domestic system would have fared any better in the rough and tumble of American water politics is, of course, open to further question. British Columbia, on the other hand, appears to have realized major economic gains, due at least in part to a significantly tighter link between technical evaluation and negotiating strategy on the Canadian team.

It is easy to relapse into cynicism and to argue that the contrast between Krutilla's thoroughly competent development of the economic approach to the problem and the end product of the Treaty negotiations simply indicates the futility of attacking on an economic front problems as inherently political as those involved in international river development schemes.

But a more useful assessment of the value of Krutilla's book must run in terms of its utility as a guide to the future, and here it surely deserves high marks. Had both sets of negotiators operated on the basis of the economic analysis of alternatives developed in Part I, a more efficient initial selection of projects and recognition of the need for long term flexibility in a system as intricate as the Columbia Basin water complex might well have been expected.

Moreover, a more thorough analysis of the elements of an optimal system and of the appropriate comparison between the optimal joint system and the best of the domestic alternatives would have permitted a little more "economy" and a little less "polity" in the mix.

JAMES A. CRUTCHFIELD

*University of Washington*

*The Economic Problems of Housing—Proceedings of a Conference held by the International Economic Association, Oxfordshire, England, April, 1965.*

Edited by ADELA ADAM NEVITT. New York: MacMillan, 1967. Pp. xxvi, 328. \$10.00.

Students of international housing policy will find much of interest in the proceedings of a conference on the Economic Problems of Housing sponsored by the International Economic Association in April, 1965. Twenty-six authors and participants, from 13 different nations, shared in the presentation and discussion of the 19 papers included in this volume. The papers, supplemented by an introduction by Sherman J. Maisel and by a skillfully prepared "Summary Record of the Debate," by the editor, present a valuable current overview of housing problems and policies in Eastern European countries in comparison with Western European countries and with those of Israel, the United States, and Africa.

The papers describing the economic problems of housing in Russia, Yugoslavia, Czechoslovakia, and Poland portray current housing problems as "most difficult," "burning," and "acute." They hold to the general philosophy that the housing problem is a part of the general problem of "social development," which "includes all services from dwellings to sports which cannot be organized individually and the characteristic of which is the collective use of funds and services" (p. 189). Policies in these nations are described as eliminating

the profit motive and requiring large-scale direct state intervention, with cooperative housing viewed as an intermediary form (p. 159). However, the descriptions of the gradual modification of systems of rent control and housing rationing in the socialist nations discussed in this volume clearly reflects the current efforts in these nations to introduce the market-pricing mechanism as a system of resource allocation.

The problems of maintaining an efficient "mixed" (controlled and free) housing market are boldly illustrated in the papers descriptive of the post-World War II performance of the housing sector in the Scandinavian countries. The long-term economic effects of government control of rents and of large-scale direct State intervention in ownership and management of rental housing are examined critically in two papers on Swedish housing and in three directed to examination of historical and other aspects of Danish housing policies. The substance of the "debate" on these and other papers by Muth, Gillies and Netzer, addressed to housing policies of the United States, would seem to eliminate the last national bastions of defense for rent controls as a feature of government housing policies *on economic grounds*. Nevitt summarizes the "Record of the Debate" on rent controls and nonmarket intervention by saying: "Mr. Stahl's model and analysis (of the Swedish housing market) supports, as do several other papers submitted to this conference, the general proposition that rents set without reference to any system of prices are not usually efficient and the houses are not allocated in a way which produces a consistent redistribution of real income" (pp. 271-72).

This outcome of economic and empirical analysis, generally accepted in the literature of the United States and of most Western nations for almost two decades, is particularly significant because it is written about and supported by data for Sweden and Denmark, bulwarks of nonprice rationing methods in the housing fields. Based on the author's personal experience, the political economists writing in the field of housing policy in these Scandinavian countries in the mid-1950s would have viewed the Conference proposition enunciated by the editor of these papers as social heresy and political, if not, professional suicide.

The rationale for the continuance of rent control and large-scale direct State intervention in housing in the United Kingdom is presented by Cullingworth's paper on "Housing and the State," although the author carefully avoids any reference to the economic justification for these policies or to the basic economic reasons for England's chronic housing problem.

Nevitt, in the "Summary Record of the Debate," suggests that the apparent ideological differences between those who defend rent controls and concomitant large-scale State intervention in the housing field, may result from a confusion in two fundamental objectives: (1) resource allocation; (2) income distribution. The editor and other participants argue effectively that rent control and housing policies generally are inefficient methods of achieving goals of redistribution of income and that the most efficient allocation of resources will be achieved through price determination in a market system (p. 272).

The participant from Russia, Nazarevsky, concludes his paper on "Economic Problems of Housing in the U.S.S.R." with the statement that "the



USSR has eliminated the serious housing shortage and within the next few years will enable the housing problem of the country to be solved completely." In addition to his forecast of an almost stupendous rise in Russian housing production from an annual level of 82.5 million square meters in 1960 to a predicted annual level of 400 million square meters in the "second decade," the author predicts that the resultant elimination of the housing shortage will "lead in time to a rent free tenancy" (pp. 239-40). How, the inquiring economist might ask, can one achieve the elimination of any shortage for any scarce good if it is to be a "free good"? Pjanic's paper on housing in Yugoslavia concludes much less hopefully and, in the eyes of this reviewer, more realistically, that "no lasting solution of the housing problem in socialism exists. Just as there does not exist an absolute need or definite aim, there is also no absolute housing need" (p. 199).

No better evidence of the value of this and of similar international economic conferences could be cited than is afforded by these contrasting statements from economists in neighboring socialistic countries.

PAUL F. WENDT

*Berkeley, California*

### Labor Economics

*Presidential Seizure in Labor Disputes.* By JOHN L. BLACKMAN, JR. Cambridge, Mass.: Harvard University Press, 1967. Pp. xvi, 351. \$10.00.

For the most part this country has regarded labor-management disputes, with losses and inconveniences to third parties as well as to the contending parties, as part of the price to be paid for private determination of the conditions of employment in organized industries. The government's role is normally that of an umpire and mediator, alert to bar unfair labor practices by either party while seeking to bring them to a mutually satisfactory agreement. At certain times, however, notably during war but also when national emergencies are created in times of peace, government becomes more directly involved in efforts to maintain production while enforcing national policies of industrial relations or price stability as enunciated by the President, by Congress, or by labor boards. One of the coercive measures employed by the government toward this end has been the seizure and temporary operation of the affected facilities.

The policies followed in seizure cases by our presidents, from Lincoln to Truman, are subjected to painstaking review and careful analysis in this well-documented study by Professor Blackman, who has assembled the facts about each of the 71 cases in our experience. Seizures have occurred in time of peace as well as during wars and in periods of reconversion. Sixty of the seizures followed enabling legislation, whereas the others relied on presidential powers independent of such Congressional action. The 71 seizures are listed chronologically in an appendix, with the date of seizure and of return, the name of the seizing and operating agency, the authority for seizure, and the reason for the seizure given for each. Methods of overcoming labor or management resis-

tance, and problems of keeping production going, of enforcing the President's labor decisions, and of settling the disputes, are treated in detail. The effectiveness of seizure is compared with other types of coercion at the disposal of the President, and used by him in other cases of resistance by unions or managements to national labor policy in emergency situations.

Throughout the book Blackman examines coercive measures at the disposal of the government from two points of view: their effectiveness in getting resumption of essential production, and the standards of public policy that are applied. In his view it is as important to treat labor and management fairly and to reconcile their interests with the public interest in wage-price stability as to choose wisely among such coercive devices at the disposal of the government as injunctions, compulsory arbitration, and seizure.

The effectiveness of seizure, Blackman argues, depends upon the President's ability to change or prevent change in the terms of employment during the period of government control, upon his power to determine when the property should be returned to private control, and upon his right to seek a court injunction against strikes, lockouts, or other forms of resistance to his operation of seized property. Because any coercive technique that is used affects the outcome of the dispute in some way, Blackman advocates conscious guidance by the President in the use of controls, to avoid unpredictable consequences or a bias that favors the same side in every case. To avoid obstruction such as that by Sewell Avery in World War II, he suggests that a wartime labor program should be embodied in legislation applicable to all major industries. He notes that cases of management noncompliance were the more difficult to settle, and that a number of legal issues remain undecided, such as whether the employees in a seized facility are federal or private employees.

In this volume Blackman has made an important contribution to our knowledge of the seizure device. In an area where controversy is readily aroused and where opinions are apt to be strongly held, he has shown that careful assemblage of facts and dispassionate analysis can aid understanding and contribute to the formulation of sound public policy.

JOEL SEIDMAN

*University of Chicago*

*The Economics of Age.* By MICHAEL J. BRENNAN, PHILIP TAFT, AND MARK B. SCHUPACK. New York: W. W. Norton & Co., 1967. Pp. ix, 246. \$7.50.

The economics of aging has been a relatively neglected field of research for economists. Indeed, those relatively few economists who have participated in such research have typically found that their findings attracted little attention in the profession. However, a number of recent developments seem likely to lead to intensified research on age variations in economic behavior. Among these are the growing interest in human capital, the newer theories of consumption, the findings of recent research on labor force participation, and the burgeoning research on poverty.

The chief contribution of the present volume lies in its application of sophisticated theoretical and analytical tools to the study of the problem of de-

clining employment opportunities for older workers. Its methodology represents a significant advance over much of the previous research on this problem and may well stimulate further work along the same lines. But the book is almost entirely concerned with this one aspect of the economics of aging, that is, with the impact of age on the individual in his role as a worker. Such important problems as age variations in the propensity to consume or to save are not considered. Nor do the authors analyze in any detail the impact of changes in the age structure of the population and labor force on the economy. Thus, one is inclined to question the statement in the preface that "no economic study of aging attempted to date is as comprehensive."

Nevertheless, the volume does include an extensive analysis of the impact of age on employment opportunities, devoting major attention to employment by industry, employment by occupation, and the role of age variations in geographic mobility. The analysis of employment by industry is based on the development of labor demand and supply equations, utilizing data from the censuses of population and manufactures for years around 1960. The authors find that economic variables affecting employment and earnings have a significantly different impact on different age groups in the labor force and that there is a "pure age" effect that operates across industries. Among the factors adversely affecting employment opportunities of older males, the most important are supplementary employer costs with more advanced age (primarily pension costs) and an inverse relationship between productivity and age from about age 45 or 50 on. These findings must be regarded as somewhat tentative and in need of further testing, since, as the authors point out, limitations in the availability of statistical data, particularly in relation to age differences in earning rates, present serious difficulties.

The chapters on geographical mobility are notable chiefly for the attention paid to differences in discounted future lifetime earnings resulting from geographical moves as a factor, often neglected in discussions of mobility, accounting for the greater attractiveness of moving to the younger individual. Occupational variations in employment opportunities of aging workers are analyzed chiefly on the basis of occupational survival rates developed from decennial census data for the years from 1900 to 1960. Although the results are of considerable interest, the findings might have been enriched if information on changing patterns of occupational shifts with advancing age, drawn from the extensive body of literature based on labor mobility surveys, had been incorporated in the analysis.

The book concludes with a series of chapters relating to the public policy implications of the findings. The need for cost-benefit analysis in connection with policy choices between programs aimed at re-employment versus improved income maintenance is rightly emphasized. On the whole, however, the authors regard improved income maintenance as the appropriate answer for the 65 and older group, whereas measures aimed at facilitating re-employment are considered desirable for the 45 to 64 age group. Although one may well agree with this view in general, some of the specific policy suggestions for the 45 to 64 age group are questionable, while the discussion of income maintenance for the 65 and older group is superficial. The statement, for example,

that "the federal government is speaking about a guaranteed annual income of 3,000 dollars for all families, including the aged," will come as something of a surprise to those who have been following the research of the Social Security Administration aimed at refining poverty-line criteria for families of various types.

It is particularly in connection with the authors' review of the data and literature relating to the declining labor force participation of elderly men, however, that their interpretation seemed questionable to this reviewer at a number of points. To mention just one of the problems, the growth of retirement benefits is largely dismissed as a factor influencing the increased departure of elderly men from the labor force on the ground that the benefits have not been of sufficient magnitude to exert a major influence. Yet there is growing evidence, in the recent work of Gallaway and others, that the availability of OASDI benefits, however inadequate in relation to living requirements, may act as a positive inducement to retirement for men who are encountering problems of declining earning capacity. This interpretation is supported by the indications, based on Social Security Administration analysis of earning records, that the large numbers of men who have been applying for reduced OASDI benefits at ages 62 to 64 since 1961 are predominantly men with severely impaired earning capacity. In other words, it is not so much the absolute level of retirement benefits, as the relationship of retirement benefits to earning capacity, that appears to be the decisive variable.

MARGARET S. GORDON

*University of California, Berkeley*

*Bargaining for Health: Labor Unions, Health Insurance, and Medical Care.*

By RAYMOND MUNTS. Madison: University of Wisconsin Press, 1967. Pp. viii, 310. \$7.50.

Health care is now a \$50 billion annual business. Private health insurance premiums are approaching \$11 billion. Yet the institutional and economic features of this rapidly burgeoning portion of the economy are relatively neglected in American scholarship. Raymond Munts' study undertakes to fill one important segment of the knowledge gap. His book is a carefully constructed and researched history and appraisal of organized labor's recent large role in the financing and organization of medical care in the United States.

The significance of that role is only partially suggested by the fact that well over 75 per cent of all private health insurance premiums are now paid through group employee-benefit plans. As the book makes clear, the character of health insurance is now greatly influenced by collectively bargained labor-management contracts. In turn, health insurance practices substantially affect medical care institutions, the extent and character of their utilization, pricing policies, and organizational arrangements. Labor's involvement, however, extends far beyond insurance. It has, for example, taken increased responsibility for direct medical services to members and their dependents through clinics, medical centers, and hospitals of their own. These too have influenced the cost and quality of medical care for the whole community.

Employers pay the largest part of the costs for employee health insurance and labor's medical centers, an estimated average of about 75 per cent. This has become an increasingly important, and complex, part of workers' compensation. Employers are alert to their growing stakes in medical care costs and practices and they too are engaged in efforts to influence them.

Medical benefits have not only added to the responsibilities and functions of unions but health bargaining, having brought both parties into the medical market as purchasers rather than in their accustomed role of producers, has given a new dimension to labor-management relations.

The many important ramifications of the book's subject matter are thus apparent. The material is presented in orderly, balanced, and thoughtful fashion. Part I primarily narrates the experiences of the major path-breaking unions, the needle trades, mineworkers, autos, and steel. Part II discusses the larger issues in health bargaining—benefits and costs, administration, financing, bargaining with insurance carriers and the various providers of health services. Part III presents a summation from which generalizations, lessons, and public policy conclusions are drawn.

Munts effectively traces developments from the "age of innocence" of the late 1940s when better health care for more people seemed merely a matter of removing the financial barrier between would-be patients and medical suppliers. The extraordinarily steep and persistent inflation of medical prices during the past 30 years soon made unions aware that they were walking a treadmill, that only a minor portion of the new money was actually purchasing additional services. For the period 1954 to 1962 "it is estimated that about one-fourth of the increase in aggregate hospital payments and two-fifths of the increase in medical payments represent net additional services to individuals that are an improvement in the scope and adequacy of benefits" (p. 98).

Unions learned that this was no ordinary commercial market which they had entered as mass consumers. To meet their objectives they would be obliged to press changes upon health insurance institutions and become aggressively concerned with the supply side of medical care—adequacy of facilities, their effective use, and pricing practices. From such activities they discovered that cost controls were intimately related with quality control. Unions have become increasingly disenchanted with the kinds and quality of service their hard-bargained funds could purchase. They have moved into more sophisticated selectivity and techniques of providing for reasonable quality. They have found that appropriate cost controls are not a threat to quality, as some had feared, but are generally conducive to higher standards of practice. Finally, unions are now recognizing that "the health interests of members are best served in terms of the health resources of the entire community" (p. 238). This advanced stage of development involves what Munts calls a "strategy of community health bargaining." Its success depends upon the intervention of government authority at several key points.

The author's evidence adequately supports his conclusions that, in addition to enlarging access to care, organized labor has been a salutary influence upon the nation's health institutions, in improving the standards of health insurance

protection—especially Blue Cross—by sensitizing its members to the importance of health care and to the differential quality of services, and sponsoring various innovations in the delivery of health care. In such activities it has tended to serve the community as a whole as well as its members. Munts does frankly face the problems arising out of such programs and the difficulties that lie ahead in a field which is still in its very early stages of maturation.

In analyzing these developments, the author gives high marks to the efficiency and quality advantages of prepaid group practice plans such as the Kaiser Foundation Health Plan on the West Coast and the Health Insurance Plan of Greater New York; stresses the value of "countervailing power" in influencing the organization and financing of medical care; and urges the need for a deliberate program of rationalizing the medical market. He seems to give support to the recent development of community and area-wide health planning and controls and implicitly urges that community health bargaining relate itself to such larger community programs—although the obstacles to this broad approach seem to me somewhat understated.

The author's recommendations are in the main moderate and evolutionary, emphasizing that future actions can only be based on labor's own experience. Both the data and conclusions are clearly presented in readable style. They add up to an interesting and significant chapter in the nation's economic and social history, well deserving the attention and thought of social scientists.

HERMAN M. SOMERS

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*Industrial Relations and Economic Development.* Edited by ARTHUR M. Ross. London: Macmillan; New York: St. Martin's Press, 1966. Pp. xxxv, 413. \$12.50.

In 1964 the International Institute for Labour Studies of the International Labour Organisation convened a two-week research conference on industrial relations and economic development. Experts from five continents discussed papers prepared for the meetings. This volume includes fourteen of the papers discussed in Geneva during August and September of 1964. It also provides an abbreviated version of a general summary and evaluation of the literature on industrial relations and economic development prepared as a background report for the conference participants by a team of I.L.O. staff members. The editor has written an informative introductory chapter. The volume does not include either the specific comments of the teams of panel discussants assigned to evaluate each of the conference papers or an edited version of general conference discussion.

This set of collected papers will be of interest to all concerned with the policy challenges presented by the variety of labor problems encountered in the course of economic development. It is the latest addition to a family of books which has stressed comparative analysis of industrial relations systems and of employment relations and manpower issues in developing countries.

The papers in this volume are grouped in four major sections. Each section deals with a critical area of policy choice in developing countries: (1) the role

of the state in industrial relations, including the problems of overt conflict and of the relations between unions and political parties; (2) the sources, functions and financing of trade union leadership; (3) the distribution of decision-making power in wage determination and the role of bargaining, legislation or other processes in shaping national incomes policies; (4) the participation of interest groups in formulating national economic plans.

In a sense, each of the latter three items is a subset of the first, but five of the papers deal more explicitly with the role of the state. Charles Gamba, for many years an adviser to policymakers in Singapore on labor relations issues, discusses the problem of developing effective labor policies in a polyethnic society such as Malaysia. Professor S. D. Punekar of the Tata Institute of Social Sciences in Bombay and Professor Subbiah Kannappan each contributed papers on the facets of state intervention in industrial relations in India. These papers together provide an excellent follow-up to the classic volume on industrial relations in India by Charles A. Myers and bring the reader up to date on the dramatic difficulties of reconciling economic development, parliamentary democracy, free, strong and responsible trade unionism, and cultural diversity.

Professor Hisashi Kawada of Keio University has an excellent paper on the business-government co-partnership in Japanese industrial relations and human resource development. Finally, Mr. T. M. Yesufu, Secretary of the Nigerian National Manpower Board, proposes some very pragmatic criteria for the assessment of appropriate governmental functions in industrial relations and resists oversimplified dichotomies in the delineation of "good" or "bad" or "model" industrial relations systems.

Mr. I. A. Ibrahim's paper on the Egyptian labor movement and Professor Frederic Meyers's paper on the relation of party, government and the labor movement in Mexico provide interesting contrasts in the possible relations of union leadership and political parties in developing countries. Meyers makes a particularly interesting case for the possibilities for considerable trade union independence in what is essentially a one-party state. Adolf Sturmthal has the outlines of a theoretical model of the evolution of sources and functions of unions over industrial time which builds on some of his earlier work on the natural history of national trade union movements and of the relative emphasis in these movements given to collective bargaining versus political action.

Elliot Berg makes a strong case against a high wages policy for urban wage earners in his paper on African wage policy, and the B. C. Roberts-L. Greyfié de Bellecombe paper describes the efficacy of collective bargaining in former British and French African countries. Their subsequent book on collective bargaining in African countries (New York, 1967) expands on the material presented in this paper.

In the final section of the book there are some extremely interesting and detailed papers on the machinery and effectiveness of interest group participation in the formulation of national, social and economic plans. R. W. Cox's paper provides a general introduction to this subject. A. Bajt's discussion of income distribution under workers' self-management in Yugoslavia is the first detailed scholarly discussion in English of the Yugoslav approach to income

distribution. Jay Tabb's paper is an intimate account of the Israeli planning process and the role of its interest groups in that process. Finally, S. Wickham has a paper on French planning which emphasizes the significant role of expert officials in the *planification et harmonisation* processes.

One of the most valuable portions of the book is the excellent annotated bibliography (almost 100 pages long) on industrial relations and economic development in general and for specific geographical areas.

The quality of these papers and of the background report is uniformly high and the editor deserves special commendation for an outstanding introductory discussion of the major questions raised at this research conference.

ABRAHAM J. SIEGEL

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### Population; Welfare Programs; Consumer Economics

✓ *Population Growth and Land Use.* By COLIN CLARK. New York: St. Martin's Press, 1967. Pp. ix, 406. \$14.00.

This is a book about population growth and land use only in the sense that its first chapters are devoted to population growth and the last ones to land use. There are hardly more than a score of pages, scattered throughout the volume, devoted to the relationship between the two. The preface warns the reader that "the student of population growth and its consequences finds himself compelled . . . to assemble information from the diverse fields of . . ." [there follows a list of 13 fields from biology to traffic engineering] and that "this book is only a preliminary attempt to survey the necessary range of material." The contents of the book justify the warning.

It surveys an enormous amount of material and writings on the subjects of fecundity and fertility, mortality, the history of world population, the carrying capacity of the world, the sociology of reproduction, the economic consequences of population increase and density, the location of industry and urban land use. The work starts with a definition of fertility and ends up, abruptly, with a map of land values in Chicago. Each chapter is a review of a subject and of its literature, with little connection between chapters, and no recognizable thread of argument. The range of material is amazing, and as an intellectual exercise accomplished by one person, the performance deserves respect. Any single reviewer cannot hope to judge adequately the discussion of each subject, but much in it is thorough, stimulating, and provocative. However, at times the coverage of the literature seemed spotty, the choice of evidence arbitrary, and there were many irritating inaccuracies.

The first chapter, for instance, attempts to discuss the subject of the reproductive capacity of the human race without ever using the word fecundity which means, in demographic usage, the capacity to bear children, in opposition to fertility, the actual performance. C. Clark attempts to describe reproductive capacity by the word *fecundibility* (instead of fecundability, the usual form; a footnote on page 1 notwithstanding, the French word is *fécondabilité*). Fecundibility refers to the probability of a woman conceiving



during a given menstrual cycle, but the terminology is used in a thoroughly confusing way throughout the chapter. At times, the period of her cycle during which a woman can conceive is called fertile; total fertilities are termed fecundibilities; and "fecundible married life" obviously does not refer to any menstrual cycles at all.

For a book which draws so much on statistical evidence, and contains many words of caution on its use, at times it is curiously unsophisticated. It criticizes—and rightly so—the Indian life tables derived by comparing two censuses; but accepts survival values based on an estimation of the age at death of a small number of Stone and Bronze Age skeletons—not to mention 22 *sinanthropi*. At one point (on p. 159) the author is not willing to accept evidence from early Indian Censuses as telling more than the total population; at another (p. 227) he accepts the ratio of children under 5 years to women aged 15 to 39 in an early census as indicating differential fertility. In a number of cases, very partial evidence is accepted as typical of a period or a continent, as on page 340 where the density of "a typical African village" is given.

The most controversial parts of the book elaborate on two premises: (1) that population growth is the only force powerful enough to make agricultural communities change their methods and become more advanced and productive; and (2) that in industrial communities, the "principal problems created by population growth are not those of poverty, but of exceptionally rapid increase of wealth in certain favoured regions . . ." (Preface). On the first point, there can be little doubt that population growth historically has acted as an agent of technical change in agriculture, although the extent to which population growth was the cause, and not the effect, is another indeterminate problem of causation of the egg-hen type. But the fact that there were civilizations which managed to provide for their growing populations by an agricultural revolution, does not mean that this is a necessary consequence. It may be that those which did not adjust to population growth and ruined the resource base of traditional cultivation, did not survive to tell the story. There are many examples today of areas where density increase is causing the soil to deteriorate because the fallow period is reduced without change of techniques, or where more intensive cultivation is successful only in accommodating more people at no improved standard of living. Certainly, there are nowadays many techniques and policies of agricultural development which should be less hazardous than unbridled population increase.

The evidence put forward on the second point, concerning industrial communities, is even less conclusive. The author invokes mainly the benefits derived from economies of scale, although he admits that there may be limits, within a short period, to the absorptive capacity of the nonagricultural sector of employment. He quotes S. Kuznets to the effect that there is no correlation in historical series between the rate of growth of real national product per head and the rate of population growth. C. Clark shows, however, that larger markets appear to go together with higher productivity. This, in itself, would be more an argument for international trade and a sustained aggregate demand, than for population increase. We are told that the latter tends to encourage savings, but the statistical evidence presented, although based mostly

on developed countries, is hardly decisive (p. 267 ff.). We are not told how the market for industrial goods in underdeveloped countries would be enlarged by the proliferation of subsistence peasants and unemployed slum-dwellers, but the fact that India has raised its rate of saving in the 1950s during a period of accelerating increase of population is given as an indication of the beneficial effect of the latter.

There is an amusing fantasy about the Mesolithic Englishmen meeting to discuss overpopulation, and deciding to take up agriculture rather than limiting their families or migrating to Scotland. Elsewhere, (p. 58) C. Clark explains that if Malthus' contemporaries in Britain had listened, "most of what is now the United States would probably have been Spanish-speaking, and Britain would probably have remained an easy-going eighteenth-century type agrarian society." It would be easy to answer that, without family limitation, Europe would now have over 2 billion inhabitants. The prospects would not be frightening to Clark, since he speculates that the world could provide food for 47 billion people at American standards of nutrition, and for 157 billion at Japanese standards. The computation, based on climatic criteria, attributes the largest productive potential to scarcely populated areas like the Amazonian and Congo forest, or New Guinea and Borneo, which just points to the Utopian character of this reasoning, which takes no account of the actual problems of economic progress and fails to distinguish the possible short-term effects of a moderate growth in industrialized regions from the disadvantages of runaway increase in nations struggling for their development.

ETIENNE VAN DE WALLE

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### Related Disciplines

*Politics, Economics, and the Public: Policy Outcomes in the American States.*

By THOMAS R. DYE. Chicago: Rand McNally & Company, 1967. Pp. xv, 314. \$6.00.

This is an interesting quantitative study by a political scientist of the determinants of outcomes in the five most important areas of state policy-making. His main conclusion is that these determinants are predominantly "economic" in character. This conclusion is reached through correlation analysis of the linkages between indicators of policy outcomes in the 50 American states and their possible economic and/or political determinants. The period to which the study relates is roughly the decade ending with 1965.

The five most important areas of state policy making are said to be education, welfare and health, highways, public regulation (essentially policing), and taxation. Eleven measures indicate the educational situation or outcome in each state; fourteen, six, thirteen, and ten measures, respectively, indicate the welfare, highways, public-regulation, and taxation situations. There are, in short, 54 policy outcome indicators, interstate differences in which are to be accounted for by economic and/or political determinants.

The four "economic" or socioeconomic determinants selected to reflect interstate differences in "economic development" are: percentage of population liv-

ing in urban areas; percentage of work force outside agriculture, fisheries and forestry; median family income in dollars, 1959; and median school year completed by population, age 25 and over. Except for low correlation between education and industrialization each of the four economic determinants is correlated significantly with each other economic determinant.

Four variables are chosen to represent the political system, interstate differences in which might account in part for interstate differences in policy outcomes in education, welfare, highways, taxation, and public regulation. These four are division of two-party control, the level of interparty competition, the level of voter participation, and the degree of malapportionment. The first three are intercorrelated, constituting a syndrome. The author reports that his findings were seldom modified by exclusion of the 11 Southern states.

The author finds that the economic and political determinants together accounted for somewhat over half of the interstate variation in the indicators of policy outcomes. The political determinants, however, exercised little independent influence. The four economic determinants affected the policy indicators both directly and through the political determinants which are dominated by the economic determinants. The author notes, however, that his model should be modified to allow for the intervening effect of federal policy. His statistical findings are presented in several summary tables. One effect of these findings is to devalue the role of some factors deemed important by political scientists.

While the author devotes considerable attention to the mechanisms that presumably underlie his correlations, more research is indicated. Then one may determine how stable the reported correlations are. One may also get at the large amount of unexplained variance and at conditions underlying the variables and relations studied. The study is indexed and well equipped with tables.

JOSEPH J. SPENGLER

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# TITLES OF NEW BOOKS

## General Economics; Methodology

- ANDREANO, R. L., FARBER, E. I. AND REYNOLDS, S. The student economist's handbook—a guide to sources. Cambridge, Mass.: Schenkman, 1967. Pp. x, 169. \$3.95; paper, \$1.50.
- BACH, G. L. Economics—an introduction to analysis and policy. 6th ed. Englewood Cliffs, N.J.: Prentice-Hall, 1968. Pp. xiv, 594. \$9.50 First pub. in 1954.
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## NOTES

A nominating committee consisting of Joseph J. Spengler, chairman, John M. Letiche, Ruth P. Mack, Robert V. Roosa, W. Phillip Saunders, Jr., and Robert Solo has submitted the following slate of nominees for 1969 officers of the American Economic Association.

### *President-Elect:*

Wassily W. Leontief, Harvard University

### *Vice-Presidents:*

Irving B. Kravis, University of Pennsylvania

Moses Abramovitz, Stanford University

Abram Bergson, Harvard University

Joe S. Bain, University of California

### *Executive Committee*

Harvey S. Perloff, Resources for the Future

Mary Jean Bowman, University of Chicago

Charles L. Schultze, Brookings Institut

Roland N. McKean, University of California, Los Angeles

The annual meeting of the Association will be held in Chicago, Illinois, December 28-30, 1968, with headquarters at the Pick-Congress Hotel.

## AER MANUSCRIPTS

The following manuscripts, exclusive of comments and replies and in addition to those listed in previous issues, have been accepted for publication in subsequent issues of the *American Economic Review*:

D. J. Aigner and S. F. Chu: On Estimating the Industry Production Function.

W. J. Baumol: On the Social Rate of Discount.

F. W. Bell: The Pope and the Price of Fish.

Louis De Alessi: Some Implications of Property Rights Structures for Investment Choice Within the Government.

S. Chakravarty and A. S. Manne: Optimal Growth When the Instantaneous Utility Function Depends upon the Rate of Change in Consumption.

Otto Eckstein and Gary Fromm: The Price Equation.

H. G. Grubel: Internationally Diversified Portfolios.

Josef Hadar and W. R. Russell: Rules for Ordering Uncertain Prospects.

F. D. Holzman: The Ruble Exchange Rate and Soviet Foreign Trade Pricing Policies 1929-1961.

S. T. Hsiao: Some Notes on the Elasticity of Substitution.

D. W. Jorgenson and C. D. Siebert: A Comparison of Alternative Theories of Corporate Investment Behavior.

David Levhari and Don Patinkin: The Role of Money in a Simple Growth Model.

James Melvin: Production and Trade with Two Factors and Three Goods.

E. J. Mishan: What is Producer's Surplus?

M. E. Moyer and D. W. Paden: On the Efficiency of the High School Economics Course.

R. R. Nelson: A "Diffusion" Model of International Productivity Differences in Manufacturing Industry.

G. H. Orcutt and A. G. Orcutt: Incentive and Disincentive Experimentation for Income Maintenance Policy Purposes.

G. H. Orcutt, H. W. Watts, and J. B. Edwards: Data Aggregation and Information Loss.

Vladimir Stoikov and R. L. Raimon: Determinants of Differences in the Quit Rate among Industries.

T. J. Wales: Distilled Spirits and Interstate Consumption Effects.

R. L. Weil, Jr.: Allocating Joint Costs.

B. A. Weisbrod and W. L. Hansen: An Income-Net Worth Approach to Measuring Economic Welfare.

### NOBEL ECONOMICS PRIZE

A new Nobel Prize, in economics, has been added to the five distributed since 1901 under the will of Alfred Nobel, the Swedish inventor of dynamite. The board of Sweden's Central Bank decided to celebrate the bank's 300th anniversary on May 15, 1968 by instituting the new prize, to be awarded for the first time in 1969. The bank will provide the funds for the economics award, which will amount to the same as other Nobel Prizes, at the moment about \$65,000. Winners are to be selected by the Swedish Royal Academy of Science, which also makes the Nobel physics and chemistry awards. Economists all over the world will have the opportunity to nominate candidates. The other Nobel Prizes are those in literature, awarded by the Swedish Academy; in physiology or medicine, by the Royal Caroline Institute, and in peace, by a five-member committee named by the Norwegian Parliament.

### VISITING SCIENTIST PROGRAM IN ECONOMICS

The American Economic Association has received a further grant from the National Science Foundation to continue its "Visiting Scientist Program in Economics" during the 1968-69 academic year. The purpose of this program is to stimulate improved teaching and interest in modern economics at colleges and universities whose major focus is at the undergraduate level. Visits to about 40 campuses have been provided by the program in 1967-68.

The NSF grant provides financing for visits to such campuses by distinguished economists, who normally will spend a day or a day and a half on such a visit. The program for each visit is planned jointly between the visitor and the host institution; customarily it includes a talk to undergraduate major students, perhaps an informal seminar with faculty and students, discussion of current course and research interests of the host faculty, and other activities as may be desirable. While the ultimate concern is to encourage greater interest in, and better teaching of, economics at the undergraduate level, visitors' talks may be on research, current developments in economics, policy issues, or other topics that may seem appropriate to the needs of the particular institution.

This program is under the general direction of the Association's Committee on Economic Education. Professor Phillip Saunders, Department of Economics, Carnegie-Mellon University, administers the program, under the policies established by the Committee. Professor Saunders works with an informal roster of economists around the country who may be available for such visits, depending on their own schedules and the degree of common interest between them and the inviting institutions. Institutions are free to suggest visitors they would especially like to have, so long as these are within a radius of 100-200 miles of the campus, in order to minimize traveling costs. The host institution is expected to provide lodging and meals for the visitor when he is on the campus; other costs will be covered by the NSF grant.

Any institution that wants further information on this program, or wishes to submit a request for a "visiting scientist" during 1968-69, is invited to write directly to Professor Phillip Saunders at Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213.

### *Announcements*

The Fourth Congress of the International Economic History Association will be held September 9-14, 1968, at Indiana University. Headquarters of the meetings will be the Indiana Memorial Union of the University. Requests for information about the program

should be addressed to Professor Jean-François Bergier, Secretary General of the International Economic History Association, University of Geneva, rue de Candolle, 1205, Geneva, Switzerland. Information about local arrangements may be obtained from Professor Ross M. Robertson, 670 School of Business, Indiana University, Bloomington, Indiana 47401.

On October 14-16, 1968, Duke University and the College on Simulation and Gaming of the Institute of Management Sciences will sponsor a symposium on "The Design of Computer Simulation Experiments with Models of Economic Systems." The symposium will be held at Duke University. Among the speakers are Albert Ando, University of Pennsylvania, Michael Evans, University of Pennsylvania, Gary Fromm, The Brookings Institution, Martin Shubik, Yale University, Daniel Teichroew, Case Western Reserve University, and Donald Watts, University of Wisconsin. For detailed information about the symposium write to Professor Thomas H. Naylor, Department of Economics, Duke University, Durham, North Carolina 27706.

The National Institute of Social and Behavioral Science will hold its regular sessions for contributed papers at the 135th annual meeting of the American Association for the Advancement of Science, December 26-31, 1968, in Dallas, Texas. Sessions are held in cooperation with the Section on Social and Economic Sciences of the A.A.A.S. Members of the American Economic Association interested in presenting a paper at these sessions are invited to forward titles and abstracts of 300 words to Donald P. Ray, Director, National Institute of Social and Behavioral Science, 863 Benjamin Franklin Station, Washington, D.C. 20044, not later than August 25th. Papers should concern well-advanced or recently completed research in any field of economics, or in interdisciplinary studies. Of particular interest would be research in labor economics.

The Federal Reserve Board is putting renewed stress on the need for improving the scope and quality of measures of price change. This is being attempted in order to permit a better understanding of the forces leading to such changes, and of the impact of alternative monetary and fiscal policies on the price level.

To accomplish these objectives, the Board has initiated a broad research program focusing on the conceptual and operating problems in the development of price measures needed for policy formulation. For this purpose, the Board has enlisted the services of a panel of distinguished scholars to work with the Board's staff in encouraging additional research in the area of prices. In some cases, it may also be possible for the Federal Reserve to facilitate the initiation of price research projects by private individuals which could not be started due to a lack of financial support.

The interests of the panel, and of the Federal Reserve, are not limited to any one area of research, but range over a wide variety of topics. For information, on the Committee and its activities, or to inquire about financial support for research projects, write to Alexander J. Yeats, Secretary, Federal Reserve Board Committee on Price Measurement, Board of Governors of the Federal Reserve System, Washington, D.C. 20551.

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The Committee on International Exchange of Persons now has a list of foreign scholars in the field of economics and business administration who have been nominated for travel grants under the Fulbright-Hays program in the event that arrangements can be confirmed for remunerative teaching or research appointments in U.S. colleges and universities for the 1968-69 academic year.

Information about these scholars will be sent to university and college officials on request. Inquiries should be addressed to: Miss Grace E. L. Haskins, Program Officer, Committee on International Exchange of Persons, Conference Board of Associated Research Councils, 2101 Constitution Ave., N.W., Washington, D.C. 20418.



*Deaths*

Ayers Brinser, summer, 1967.

Curtis M. Elliott, professor of economics, University of Nebraska, January 9, 1968.

Milford K. Kellogg, professor of accounting, Butler University, March 3, 1968.

Paul W. McGann, December 24, 1967.

John Parker, associate professor of economics, University of Michigan, December 22, 1967.

Charles J. Scully, professor of economics, Boston College, September 24, 1967.

Wayne C. Taylor, trustee, National Planning Association and member, Committee for Economic Development, November 22, 1967.

Charles M. Tiebout, professor of economics, University of Washington, January 16, 1968.

Carl F. Wehrwein, December 29, 1967.

*Retirements*

Harold M. Eswine, professor of economics, College of Business Administration, Kent State University, June 1968.

Robert Ford, associate professor of economics, University of Michigan, July 1, 1968.

Edward B. Schmidt, professor of economics, University of Nebraska, June 1968.

John H. Sheehan, associate professor of economics, University of Notre Dame, June 1968.

John G. Smale, professor of economics, Chico State College, June 1968.

Philip Taft, professor of economics, Brown University, June 1968.

James M. Waller, professor of banking and finance, College of Business Administration, University of Georgia.

*Visiting Foreign Scholars*

George C. Archibald, University of Essex: visiting professor of economics, University of Washington, summer 1968.

Sukhamoy Chakravarty, University of Delhi: visiting professor of political economy, Johns Hopkins University, 1968-69.

Michael Davenport, University of York: visiting associate professor of finance, Graduate School of Business Administration, New York University.

P. Sargent Florence, professor emeritus, University of Birmingham: visiting distinguished professor, University of Rhode Island, spring 1968.

S. Herbert Frankel, University of Oxford: visiting professor of economics, University of Virginia, spring 1968.

Georgui T. Georgiev, Institute of Economics and Organization of Agriculture, Bulgarian Academy of Agricultural Sciences: visiting research specialist, department of agricultural economics, University of Minnesota.

Robert G. Gregory, London School of Economics: visiting assistant professor, Northwestern University, fall 1968.

Ronald M. Hartwell, University of Oxford: visiting professor of economics, University of Virginia, spring 1969.

Sultan Hashmi: visiting professor, University of Pittsburgh, April 1968.

Branko Horvat: visiting scholar, department of economics, University of Michigan, March 1-June 30, 1968.

Anthony Lancaster, University of Birmingham: visiting associate professor of economics, University of Washington, 1968-69.

Assar Lindbeck, Stockholm School of Economics: Wesley Clair Mitchell Research Professorship, Columbia University, 1968-69.

Nissan Liviatan, The Hebrew University: visiting professor of economics, Massachusetts Institute of Technology, 1968-69.

James A. Mirrlees, Oxford University: visiting professor of economics, Massachusetts Institute of Technology, spring 1968.

Balwanth Reddy, University of Essex: visiting lecturer in economics, Northwestern University, fall 1968.

Hedley J. B. Rees, University of Nottingham: visiting assistant professor of statistics, Massachusetts Institute of Technology, 1968-69.

Brinley Thomas, University College, Cardiff: Hinkley Professor, department of political economy, Johns Hopkins University, fall 1968.

Hermann von Steun, Nancy, France: visiting lecturer in marketing, School of Commerce and Business Administration, University of Alabama.

### *Promotions*

Guvenc Alpander: associate professor of management, University of Maine.

Robert E. Berney: associate professor of economics, Washington State University.

H. Marshall Booker: assistant professor of economics, Old Dominion College.

Leonard E. Chadwick: associate professor of economics, San Diego State College, September 1968.

Herbert A. Chesler: associate professor, University of Pittsburgh, fall 1968.

George deMenil: assistant professor of economics, Boston College.

John V. Donovan: assistant professor of economics, Whittemore School of Business and Economics, University of New Hampshire, February 1968.

Wilson L. Farman: professor of economics, Colgate University, July 1, 1968.

Roderick A. Forsgren: associate professor of management, University of Maine.

William L. Henderson: John E. Harris Professor of Economics, Denison University.

James O. Horrigan: associate professor of business administration, Whittemore School of Business and Economics, University of New Hampshire, February 1968.

Chi-Ming Hou: first Charles A. Dana Professor of Economics, Colgate University, February 1, 1968.

Donald L. Huddle: associate professor of economics, Rice University.

William R. Hughes: associate professor of economics, Boston College.

Ronald L. Jensen: associate professor of business administration, Emory University.

Leroy Johnson: associate professor of business administration, Washington State University.

Ronald W. Jones: Munro Professor of Economics, University of Rochester.

Edward J. Kane: professor of economics, Boston College.

John W. Korbel: associate professor of business administration, Whittemore School of Business and Economics, University of New Hampshire, February 1968.

Marian Krzyzaniak: professor of economics, Rice University.

Lester B. Lave: associate professor of economics, Graduate School of Industrial Administration, Carnegie-Mellon University.

Ferdinand K. Levy: professor of economics, Rice University.

Stephen R. Lewis Jr.: associate professor of economics, Williams College.

Gary A. Luoma: associate professor of business administration, Emory University.

Asatoshi Maeshiro: associate professor, University of Pittsburgh.

Melvin T. McClure: associate professor of accounting, University of Maine.

Robert J. McEwen: professor of economics, Boston College.

Timothy McGuire: assistant professor of economics, Graduate School of Industrial Administration, Carnegie-Mellon University.

Lionel W. McKenzie: Wilson Professor of Economics, University of Rochester.

Francis M. McLaughlin: associate professor of economics, Boston College.

Jack W. Nickson Jr.: professor of economics, Old Dominion College.

Leroy E. Pagano: instructor, School of Business Administration, The American University, fall 1968.

Doris G. Phillips: professor of economics, California State College at Fullerton.

Charles Plott: associate professor of economics, Krannert Graduate School of Industrial Administration, Purdue University.

Perry L. Roets: department of economics, Marquette University.

Robert Rogow: associate professor, department of economics and commerce, Simon Fraser University.

Richard Roll: assistant professor of economics, Graduate School of Industrial Administration, Carnegie-Mellon University.

David Rutenberg: assistant professor of economics, Graduate School of Industrial Administration, Carnegie-Mellon University.

Kehar S. Sangha: professor of economics, Old Dominion College.

Thomas Sargent: assistant professor of economics, Graduate School of Industrial Administration, Carnegie-Mellon University.

Lewis M. Schneider: associate professor of business administration, Harvard University, July 1, 1968.

Nancy L. Schwartz: associate professor of economics, Graduate School of Industrial Administration, Carnegie-Mellon University.

Stephen L. Shapiro: assistant professor of economics, Old Dominion College.

Morris Silver: associate professor of economics, The City College of The City University of New York.

Kenneth H. Smith: associate professor of economics, Hunter College of The City University of New York, January 1, 1968.

Leon Smolinski: professor of economics, Boston College.

Kenneth T. Strand: professor, department of economics and commerce, Simon Fraser University.

Akira Takayama: professor of economics, Krannert Graduate School of Industrial Administration, Purdue University.

Joseph R. Tarbet: professor of business administration, Washington State University.

George J. Viksnins: associate professor of economics, Georgetown University, fall 1968.

Dwayne Wrightsman: associate professor of finance, Whittemore School of Business and Economics, University of New Hampshire, February 1968.

Gerald L. Young: assistant professor of economics, Washington State University.

### *Administrative Appointments*

Ernest J. Bartell: chairman, department of economics, University of Notre Dame.

Philip W. Bell, Haverford College and Lincoln University: provost, Merrill College, University of California at Santa Cruz.

Wilbur E. Benson, Florida Atlantic University: professor of banking and finance and dean, College of Business Administration, University of Akron, July 1, 1968.

Joseph C. Blumel: dean of undergraduate studies and associate dean of the faculties, Portland State College.

Diran Bodenhorn: acting chairman, department of economics, Ohio State University.  
Alice E. Bourneuf: vice chairman, department of economics, Boston College.

Edmund Brunner Jr.: associate head, department of economics, The RAND Corporation.

Rockwood Q. P. Chin, Wheaton College: professor of economics and assistant dean of the Graduate School, University of Connecticut.

Paul G. Craig: dean, College of Social and Behavioral Sciences, Ohio State University.

Dale L. Cramer: acting head, department of economics, School of Commerce and Business Administration, University of Alabama, 1967-68.

Peter L. Danner: associate professor and chairman, department of economics, Marquette University.

Doris M. Drury: professor of economics, Division of Administrative Environment, and chairman, Division of Research, College of Business Administration, University of Denver.

J. Robert Maddox: chairman, Division of Administrative Environment, College of Business Administration, University of Denver.

J. Carter Murphy: chairman, department of economics, Southern Methodist University.

Charles L. Quittmeyer: dean, School of Business Administration, College of William and Mary.

Daniel B. Rathbun, General Accounting Office, Washington, D.C.: director of planning and professor of economics, University of Pittsburgh, January 1968.

Albert Rees: director, Industrial Relations Section, Princeton University, July 1, 1968; succeeding Frederick H. Harbison, who is continuing as faculty associate.

Donald Sternitzke: acting chairman, department of economics, Bowling Green State University, 1968.

Thomas R. Swartz: associate chairman, department of economics, University of Notre Dame.

Alfred Tella, Federal Reserve Board: director, Labor Force Studies, President's Commission on Income Maintenance Programs, March 18, 1968.

Charles Wolf Jr.: head, department of economics, The RAND Corporation.

### *Appointments*

Mark Aldrich, University of Texas: assistant professor, Smith College.

John J. Andrews: associate professor of business administration, Emory University, September 1968.

Orley C. Ashenfelter: assistant professor of economics, Princeton University.

Allan R. Bailey: assistant professor of accounting, School of Business Administration, San Diego State College, February 1, 1968.

Robert Barro: assistant professor of economics, Brown University.

Richard E. Bennett: assistant professor of economics, College of Business Administration, Kent State University.

David Black: assistant professor of economics, Duke University, September 1968.

Frank J. Bonello: assistant professor of economics, University of Notre Dame, fall 1968.

H. James Brown, Indiana University: research staff associate, National Bureau of Economic Research.

John P. Brown: assistant professor of economics, Brown University.

Charles E. Butler: assistant professor of economics, University of Texas, spring 1968.

Sidney L. Carroll: assistant professor, Louisiana State University.

Steven N. S. Cheung: assistant professor of economics, University of Chicago, fall 1968.

Edwin Clark: visiting assistant professor of economics, Williams College.

Norris C. Clement, University of Colorado: assistant professor, San Diego State College.

Claude S. Colantoni: assistant professor of management and economics, Krannert Graduate School of Industrial Administration, Purdue University, September 1968.

Herman E. Daly, University of Ceara, Brazil: associate professor, Louisiana State University.

Eric G. Davis: assistant professor of economics, Krannert Graduate School of Industrial Administration, Purdue University, September 1968.

Horace B. Davis: special professor of economics, Hofstra University, spring 1968.

Karen Davis: instructor in economics, Rice University, July 1968.

Don J. DeVoretz: instructor, department of economics and commerce, Simon Fraser University.

W. Erwin Diewert: assistant professor of economics, University of Chicago, fall 1968.

John T. Donnelly: assistant professor, College of Economics & Business, Washington State University.

Margaret B. Dray: lecturer, Chicago City College.

Michael Duggan: associate visiting professor of economics, Whittemore School of Business and Economics, University of New Hampshire, 1967-68.

Mohamed El Hodiri: visiting associate professor of economics, University of Kansas, September 1968.

Daniel Ellsberg, Department of State: staff member, economics department, The RAND Corporation, summer 1967.

Ray C. Fair, Massachusetts Institute of Technology: assistant professor of economics, Princeton University.

Richard Fenton: assistant professor of economics, State University of New York, College at Brockport.

Filemon Flores, Jr., California State College: assistant professor of business management, School of Business Administration, The American University, fall 1968.

Robert W. Fogel, University of Chicago: professor of economics, University of Rochester, each fall quarter, beginning fall 1968.

N. Allen Ford: assistant professor, College of Economics & Business, Washington State University.

Bruce L. Gardner: assistant professor of economics, North Carolina State University, fall 1968.

Marshall Geer III: assistant professor of economics, University of Colorado, September 1968.

Martin Geisel: research associate in economics, Graduate School of Industrial Administration, Carnegie-Mellon University.

Alan L. Ginsburg: assistant professor, The City College of The City University of New York, January-December 1968.

Herbert Glazer, Sophia University, Tokyo: associate professor of marketing and international business, School of Business Administration, The American University, fall 1968.

Roger C. Gledhill: assistant professor of economics, Old Dominion College.

Frederick L. Golladay: assistant professor, University of Wisconsin, Madison.

Robert J. Gordon: assistant professor of economics, University of Chicago, fall 1968, and research staff associate, National Bureau of Economic Research.

Leon S. Graubard: assistant professor of economics, Northeastern University.

Horace M. Gray: visiting professor of economics, University of Texas, spring 1968.

Kenneth V. Greene: assistant professor of economics, State University of New York at Binghamton.

Thomas J. Grenenes: assistant professor of economics, North Carolina State University, fall 1968.

Louis Guth: assistant professor, School of Commerce and Graduate School of Business Administration, New York University.

Merlin M. Hackbart: assistant professor, College of Commerce and Industry, University of Wyoming.

Joseph Hamilton, Chico State College: staff member, logistics department, The RAND Corporation, summer 1967.

Michael Hartley: assistant professor of economics, Duke University, September 1968.

Robert L. Heilbroner: professor, Graduate Faculty, New School for Social Research.

Larry M. Hersh: instructor in economics, Northeastern University.

Robert L. Higgs: acting assistant professor of economics, University of Washington, 1968-69.

Terry M. Hogan: assistant professor of economics, Northwestern University, Evanston, fall 1968.

Janos Horvath: professor of economics, Butler University.

Mamoru Ishikawa, University of Pittsburgh: Catholic University, fall 1968.

Joseph M. Jadow Jr.: department of economics, Oklahoma State University, September 1, 1968.

Dwight M. Jaffee, Massachusetts Institute of Technology: assistant professor of economics, Princeton University.

Frank J. Jones: assistant professor of economics, University of Notre Dame, fall 1968.

Arthur E. Kartman, University of Washington: assistant professor, San Diego State College.

Peter E. Kennedy, University of Wisconsin: visiting assistant professor of economics, Cornell University, spring 1968.

Richard E. Kihlstrom: assistant professor of economics, Northwestern University, Evanston, fall 1968.

Paul S. Kirshenbaum: assistant professor of economics, Hunter College of The City University of New York, September 1, 1967.

James T. Kneafsey, Ohio State University: assistant professor, University of Pittsburgh, fall 1968.

Arnold F. Kroner, Cornell University: assistant professor, University of Pittsburgh, fall 1968.

George M. Lady, Rice University: Resource Management Corporation, Bethesda, June 1968.

Duane E. Leigh: assistant professor, College of Economics & Business, Washington State University.

Charles A. Lenard: instructor, College of Economics & Business, Washington State University.

Sar A. Levitan, Upjohn Institute: research professor of economics, George Washington University, 1967-68.

Kevin M. Lightner: assistant professor of accounting, School of Business Administration, San Diego State College.

Charles H. Little, Oklahoma State University: assistant professor, departments of experimental statistics and economics, North Carolina State University, fall 1968.

Cliff L. Lloyd, Krannert Graduate School of Industrial Administration, Purdue University: professor of economics, State University of New York at Buffalo.

Oscar M. Lund Jr., Bethel College: research fellow, department of agricultural economics and Agricultural Extension Service, University of Minnesota.

Murugappa C. Madhavan, University of Wisconsin: assistant professor, San Diego State College.

Wilbur R. Maki, Iowa State University: professor of agricultural economics and coordinator of resources and community development, Agricultural Experiment Station, University of Minnesota.

Garth L. Mangum, Upjohn Institute: research professor of economics, George Washington University, 1967-68.

Paul J. Markowski: lecturer in economics, Brooklyn College.

Joseph R. Mason: assistant professor of economics, State University of New York, College at Brockport.

B. John Mathis: associate professor of economics, State University of New York, College at Brockport.

Charles McConnel: instructor in economics, Occidental College.

E. William McElroy, University of Buffalo: assistant professor, Georgetown University.

Earl C. McFarland: assistant professor of economics, Williams College.

John S. McGee, University of North Carolina: professor of economics, University of Washington, 1968-69.

Stephen K. McKnees: assistant professor of economics, Williams College.

Charles Metcalf: assistant professor, University of Wisconsin, Madison.

Robert H. Meyer Jr.: assistant professor of economics, Krannert Graduate School of Industrial Administration, Purdue University, September 1968.

Frank B. Miller, Cornell University: visiting professor, department of economics and commerce, Simon Fraser University.

Roger L. Miller: acting assistant professor of economics, University of Washington, 1968-69.

William J. Moore, University of Texas: assistant professor of economics, University of Oklahoma, September 1, 1968.

Woo Hyun Nam, University of Washington: assistant professor, San Diego State College.

Ranganathan Narayanan: research associate in economics, Graduate School of Industrial Administration, Carnegie-Mellon University.

David M. Nelson: research associate, department of agricultural economics and Agricultural Extension Service, University of Minnesota.

Walter L. Ness Jr.: assistant professor of finance, Graduate School of Business Administration, New York University.

Walter Nicholson: assistant professor of economics, Amherst College, July 1968.

Norman P. Obst: acting assistant professor of economics, University of Washington, 1968-69.

Jack Ochs, Washington University: assistant professor, University of Pittsburgh, fall 1968.

Jan Parker: associate professor of economics, Sweet Briar College.

Lewis Perl: assistant professor of industrial and labor relations, New York State School of Industrial and Labor Relations, Cornell University, February 1969.

Nicholas S. Perna: assistant professor of economics, Williams College.

Richard K. Perrin: assistant professor of economics, North Carolina State University, spring 1968.

Jonathan J. Pincus: instructor, department of economics and commerce, Simon Fraser University.

J. Eugène Poirier: assistant professor, Georgetown University.

Michael G. Porter: instructor, department of economics and commerce, Simon Fraser University.

Richard H. Puckett, The American University: adviser, Board of Governors of the Federal Reserve System.

Laura R. Randall: assistant professor of economics, Hunter College of The City University of New York, February 1, 1968.

V. Lane Rawlins: assistant professor, College of Economics & Business, Washington State University.

Uwe E. Reinhardt, Yale University: assistant professor of economics, Princeton University.

Roger Riefler: assistant professor, University of Pittsburgh, fall 1968.

Kjell A. Ringbakk: assistant professor of marketing, School of Business Administration, San Diego State College.

Herbert J. Roth: assistant professor of economics, College of Business Administration, Kent State University.

Michael Rothschild: instructor in economics, Boston College.

Charles M. Sackrey Jr., Ithaca College: assistant professor, Smith College.

Warren J. Samuels, University of Miami: department of economics, Michigan State University, September 1, 1968.

Edward Selby, North Eastern Louisiana State College: associate professor of banking and finance, College of Business Administration, University of Georgia.

William R. Sherrard: assistant professor of management, School of Business Administration, San Diego State College, September 1968.

Roger B. Skurski: assistant professor of economics, University of Notre Dame, fall 1968.

D. Stanton Smith: assistant professor, College of Economics & Business, Washington State University.

Gordon Smith, University of California, Berkeley: assistant professor, Rice University, July 1, 1968.

David W. Stevens: department of economics, Oklahoma State University, August 1, 1968.

Bernt Stigum: associate professor of economics, Northwestern University, Evanston, fall 1968.

Vladimir Stoikov: visiting professor of industrial and labor relations, New York State School of Industrial and Labor Relations, Cornell University, 1968-69.

Ernst W. Stromsdorfer: associate professor of economics, Pennsylvania State University.

Raymond Struyk, Washington University: research staff associate, National Bureau of Economic Research.

Richard E. Sylla: assistant professor of economics, North Carolina State University, fall 1968.

Phillip Taft, Brown University: visiting professor of industrial relations, State University of New York, Buffalo, 1968-69.

Peter Temin, Massachusetts Institute of Technology: research staff associate, National Bureau of Economic Research.

Henry Thomassen, Emory University: associate professor, University of Nebraska.

Cecilia V. Tierney: associate professor, College of Economics & Business, Washington State University.

Richard F. Trestail: associate professor of economics, Marquette University.

Martin A. Ulrich: instructor, department of economics and commerce, Simon Fraser University.

James Verbrugge, University of Kentucky: associate professor of banking and finance, College of Business Administration, University of Georgia.

Fritz Von Beek: instructor in economics, The American University, 1968-69.

William C. Wedley, University of Libya: instructor, department of economics and commerce, Simon Fraser University.

Kelso L. Wessel: associate professor, department of agricultural economics and rural sociology, Ohio State University, and member, Ohio State Contract Team in Piracicaba, Brazil.

Richard E. Westin: assistant professor of economics, Northwestern University, Evanston, fall 1968.



Larry E. Westphal, Harvard University: assistant professor of economics, Princeton University.

James E. Williamson: assistant professor of accounting, School of Business Administration, San Diego State College, September 1968.

Nail C. Yucel: assistant professor, College of Economics & Business, Washington State University.

### *Leaves for Special Appointments*

Leland S. Burns, University of California, Los Angeles: Netherlands Economic Institute and Netherlands School of Economics, Rotterdam, 1968.

Martin K. Christiansen, University of Minnesota: Economic Research Service, Department of Agriculture, Washington, D.C.

Peter Franck, Syracuse University: visiting professor of economics, Columbia University, spring 1969.

George W. Hilton, University of California, Los Angeles: acting curator of transportation, Smithsonian Institution, 1968-69.

William N. Leonard, Hofstra University: consultant, Federal Trade Commission, Washington, D.C.

Cono Casella, Arthur T. Roth Graduate School of Business Administration: Fulbright lecturer in economics, Johns Hopkins University in Bologna, 1968-69.

Morris D. Morris, University of Washington: The Institute for Advanced Study, Princeton University, in an experimental program in the study of social change, 1968-69.

Sam Peltzman, University of California, Los Angeles: Graduate School of Business, University of Chicago, 1968-69.

Orme W. Phelps, Claremont Men's College: visiting professor of economics, State University of New York, College at Brockport, 1968-69.

Charles J. Siegman, Federal Reserve Board, Washington, D.C.: consultant, Bank for International Settlements, Basle, January-June 1968.

Harold M. Somers, University of California, Los Angeles: Yale Law School, Yale University, fall 1968.

Richard K. Stuart, Whitman College: Fulbright lecturer in business and economics, Faculty of Public and Business Administration, University of Tehran, 1967-68.

Clemens B. Thoman, University of Nebraska: visiting professor, Pahlavi University, Shiraz, Iran.

George J. Viksnins, Georgetown University: program economist, Agency for International Development, Bangkok, 1968-70.

Dean A. Worcester Jr., University of Washington: extended Rockefeller Foundation Fellowship, University of the Philippines, 1968-69.

### *Resignations*

Herbert M. Bernstein, Washington and Jefferson College, June 1968.

Paul Medow, New School for Social Research.

### *Miscellaneous*

Gardner Ackley, University of Michigan: appointed U.S. Ambassador to Italy, March 1968.

O. B. Jesness, professor emeritus, University of Minnesota, awarded a 50th Anniversary Commemorative Medal by the Federal Land Bank for outstanding contributions to agriculture.

E. Fred Koller, University of Minnesota, awarded a 50th Anniversary Commemorative Medal by the Federal Land Bank for outstanding contributions to agriculture.

# THE AMERICAN ECONOMIC REVIEW

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Manuscripts and editorial correspondence relating to the regular quarterly issue of this Review should be addressed to John G. Gurley, Managing Editor of THE AMERICAN ECONOMIC REVIEW, Stanford University, Stanford, California 94305. *Style Instructions* for guidance in preparing manuscripts in acceptable form will be provided upon request to the editor.

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# The American Economic Review

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## A COMPARISON OF ALTERNATIVE THEORIES OF CORPORATE INVESTMENT BEHAVIOR

By DALE W. JORGENSON AND CALVIN D. SIEBERT\*

The purpose of this paper is to compare alternative theories of investment behavior with regard to their ability to explain the investment activity of corporations. The theories we consider have already undergone substantial empirical testing and all of them deserve careful consideration as possible explanations of investment behavior. Unfortunately, the evidence already available is not sufficient to provide an adequate comparison of the alternative theories. Given a correct specification of the lag structure underlying the investment process, time series data for industry aggregates do not provide sharp discrimination among alternative explanations of investment behavior.<sup>1</sup> Studies of cross section data on the investment activity of individual firms exhibit little stability over time so that any comparisons based on observations for corporations must first provide a satisfactory explanation of the observations for individual firms over time.<sup>2</sup> In this study we concentrate on time series data for a small but representative sample of firms selected from the *Fortune* Directory [14] of the 500 largest U.S. industrial corporations for 1962. For each individual firm we determine an appropriate specification of the lag between changes in demand for capital and investment expenditures under each of five alternative theories of the demand for capital. We find that the results enable us to discriminate quite sharply among alternative theories of investment.

The point of departure for this study is the flexible accelerator model of investment behavior originated by Chenery [2] and Koyck [29]. In this model attention is focused on the time pattern of investment behavior. The firm is taken to have a desired level of capital, determined by long-run considerations. The precise specification of the desired level of capital has been the subject of a wide variety of alternative

\* Dale W. Jorgenson is professor of economics at the University of California, Berkeley; Calvin D. Siebert is associate professor of economics at the University of Iowa. Support for this research was provided by the National Science Foundation.

<sup>1</sup> See, for example, the results of Griliches and Wallace [16].

<sup>2</sup> This point has been emphasized by Kuh [30, esp. Ch. 5, pp. 116-57].

theories of investment behavior. The alternative theories do agree, however, on the validity of the fundamental flexible accelerator mechanism for translating changes in desired capital into actual investment expenditures. Denoting the actual level of capital in period  $t$  by  $K_t$  and the desired level by  $K_t^*$ , capital is adjusted toward its desired level by a certain proportion of the discrepancy between desired and actual capital in each period,

$$(1) \quad K_t - K_{t-1} = [1 - \lambda][K_t^* - K_{t-1}].$$

Alternatively, actual capital may be represented as a weighted average of all past levels of desired capital,

$$(2) \quad K_t = [1 - \lambda] \sum_{\tau=0}^{\infty} \lambda^{\tau} K_{t-\tau}^*.$$

We refer to the latter form of the flexible accelerator as a distributed lag function with actual capital in period  $t$  a function of desired levels of capital. The average lag of adjustment is  $\lambda/[1-\lambda]$ . This lag represents the average time required for a change in desired capital that persists indefinitely to be translated into a change in actual capital stock.

The flexible accelerator mechanism can be transformed into a complete theory of investment behavior by adding a model of replacement investment and a specification of the desired level of capital. By accounting definition the change in capital from period to period is equal to gross investment less replacement investment. The flexible accelerator provides an explanation of change in capital, but not of gross investment. The choice of a model of replacement is important since replacement investment predominates in investment expenditures, at least at the aggregate level.<sup>3</sup> A simple model that has been widely adopted for empirical work is that replacement is proportional to actual capital stock. Under this assumption the accounting definition for change in capital may be written,

$$(3) \quad K_t - K_{t-1} = I_t - \delta K_{t-1},$$

where  $\delta$  is the rate of replacement, a fixed constant. This model of replacement investment can be supported on grounds of empirical validity. In repeated tests on the aggregate level<sup>4</sup> and for individual firms<sup>5</sup> this theory has been proved satisfactory as a representation of replacement investment. These empirical results support the validity of the asymptotic approximation that replacement is proportional to capital

<sup>3</sup> See Kuznets [31, Table 8, pp. 92-93]; capital consumption has dominated gross capital formation for the economy as a whole since 1919.

<sup>4</sup> See Jorgenson [23, p. 254] and Jorgenson and Stephenson [25, pp. 192-212].

<sup>5</sup> See Meyer and Kuh [37, pp. 91-94].

stock for populations of investment goods whatever the underlying distribution of replacements for individual items.<sup>6</sup> Combining the accounting identity given above with the flexible accelerator mechanism,

$$I_t - \delta K_{t-1} = [1 - \lambda][K_t^* - K_{t-1}],$$

we obtain a model of investment expenditures,

$$(4) \quad I_t = [1 - \lambda][K_t^* - K_{t-1}] + \delta K_{t-1}.$$

To complete the theory of investment behavior it is necessary to add to the flexible accelerator mechanism and the model of replacement investment a specification of the desired level of capital stock. At this point alternative theories of investment behavior diverge. In the empirical studies of Chenery and Koyck the level of desired capital was assumed to be proportional to output. The corresponding theory of investment is often referred to as the capacity utilization theory since high levels of investment expenditure are associated with high ratios of output to capital and low levels of investment with low ratios of output to capital. An alternative theory of investment is that desired capital is proportional to profit. Two alternative rationalizations of this theory have been offered. First, Tinbergen argues that realized profits measure expected profits and that "it is almost a tautology to say that investment is governed by profits expectations."<sup>7</sup> Secondly, the rate of investment may be constrained by the supply of funds. In the strong version of this theory the financial constraint operates at all times; the cost of funds schedule becomes highly inelastic where internal funds are exhausted. In a weaker version of the theory the financial constraint operates at low rates of capacity utilization while extreme pressure on capacity may result in the use of outside sources of finance.<sup>8</sup> Both the capacity utilization and profits theories of investment were originally propounded as alternatives to the rigid accelerator theory. In this theory investment is simply proportional to changes in output. The rigid accelerator was rejected in tests by Kuznets [32], Tinbergen [50], Chenery [2], Koyck [29], and Hickman [20].

Much effort has been devoted to comparison of profits and capacity utilization theories of investment behavior. The culmination of this work is Kuh's intensive study of some 30 different equation forms for the two theories and for combinations of both. Kuh found negative results for nearly all tests of intertemporal homogeneity of cross sections

<sup>6</sup> See Feller [13, pp. 286-93].

<sup>7</sup> Tinbergen [51, p. 34].

<sup>8</sup> The liquidity theory is discussed by Meyer and Kuh [37, esp. Ch. 13, pp. 190-208], Anderson [1], Meyer and Glauber [36] and Kuh [30]. A theoretical analysis of the liquidity approach is presented by Duesenberry [7, esp. Ch. 5].



and homogeneity across firms for time series.<sup>9</sup> He emphasizes the results from time series, concluding, "Since the major objective is to improve understanding of dynamic, time series behavior, it should be pointed out that no matter how the contrasts are drawn from time series, the acceleration sales model is superior to the internal fund flow, profit model."<sup>10</sup> An alternative attack on the use of current profits has been made by Grunfeld. He incorporates profits into a flexible accelerator model and finds that the partial correlation of profits and investment, given capital stock, is insignificant. "Our results do not confirm the hypothesis that profits are a good measure of those expected profits that will tend to induce investment expenditures. The observed simple correlation between investment and profits seems to be due to the fact that profits are just another measure of the capital stock of the firm and one that is in most cases inferior to the measure that we have constructed."<sup>11</sup> Grunfeld suggests that discounted future earnings less the costs of future additions to capital provides a better measure of expected profits than current realized profits. In Grunfeld's theory desired capital is proportional to the market value of the firm in the securities markets. Combining Koyck's specification of distributed lags with Tinbergen's profits model, Grunfeld was able to show that realized profits are not an adequate measure of expected profits. An implication of Grunfeld's results is that previous empirical tests of the determinants of investment expenditures should be re-evaluated in the light of Koyck's superior treatment of the time structure of investment behavior.

At the outset of econometric studies of investment behavior in Tinbergen's monograph, *Statistical Testing of Business Cycle Theories*, the neoclassical theory of optimal capital accumulation was considered a serious alternative to the rigid accelerator as an explanation of investment. Explanations based on the neoclassical theory were tested by Tinbergen, subsequently by Roos [45], [46], and by Klein [27], [28]. In these studies the theory of optimal capital accumulation was employed primarily as a source of possible explanatory variables—interest rates, relative prices, and so on. Tinbergen found a significant effect for interest rates in only one of five sets of data he examined.<sup>12</sup> Negative results were also reported by Klein.<sup>13</sup> In these tests of the neoclassical theory little attention was paid to the measurement of the cost of capital, the tax treatment of business income, or to the way that the cost of capital, the tax structure, and the price of capital goods enter the

<sup>9</sup> Kuh [30, Ch. 6, pp. 158–88].

<sup>10</sup> Kuh [30, p. 213].

<sup>11</sup> Grunfeld [17, p. 219]. See also, Eisner [8–10].

<sup>12</sup> Tinbergen [51].

<sup>13</sup> See Klein [27] [28].

demand for capital services. Perhaps most important, none of these tests was based on a proper specification of the lag structure from changes in desired capital to investment expenditures. A re-evaluation of the neoclassical theory of optimal capital accumulation as an explanation of investment behavior has been undertaken by Jorgenson and Stephenson [25].<sup>14</sup> Their results suggest that the neoclassical theory of investment merits consideration as an alternative to the capacity utilization and profits theories.

Given that profit expectations determine investment behavior, the empirical results of Grunfeld and Kuh suggest that profit expectations cannot be adequately represented by current realized profits. Kuh points out that, "... the expectational hypothesis for profits cannot, and perhaps should not, be distinguished from the sales level or capacity accelerator hypothesis. The main candidate variable for the expectational hypothesis is simply net income after tax, a secondary candidate being gross operating profit. Both variables will have strong correlations with the level of sales."<sup>15</sup> In this study we retain the profits model as a possible specification of the desired level of capital; however, we choose as our measure of profits the flow of internal funds available for investment. The basic premise of the corresponding theory of investment behavior is that the supply of funds schedule rises sharply at the point where internal funds are exhausted. We call this the Liquidity theory of investment. In view of the strong empirical support for the capacity utilization theory from the results of Kuh and from those of Eisner [8-12] and Hickman [21], we take desired capital to be proportional to output as a possible explanation of investment expenditures. We call this the Accelerator theory of investment. Finally, Grunfeld's results suggest that profit expectations can best be measured by the market value of the firm, so that desired capital is proportional to market value. We call this the Expected Profits theory of investment. All three theories will be included in our comparison of alternative explanations of investment behavior.

The neoclassical theory of investment behavior is based on an optimal time path for capital accumulation. It also implies a theory of the cost of capital. This theory has been developed by Modigliani and Miller [38-43]. In the Modigliani-Miller theory the cost of capital is shown to be independent of the financial structure of the firm or of dividend policy; this view contrasts sharply with the theory of the cost of capital underlying the liquidity theory of investment behavior. In the liquidity theory the supply schedule is horizontal up to the point at which internal funds are exhausted and vertical at that point. If interest payments are deductible for tax purposes, the Modigliani-Miller view must be

<sup>14</sup> See also Jorgenson [22] [23] and Jorgenson and Stephenson [26].

<sup>15</sup> Kuh [30, p. 208; see also, pp. 12-22], and Eisner [9, p. 8].

qualified.<sup>16</sup> The appropriate cost of capital for investment decisions is still a weighted average of the expected return to equity and the return to debt. Return to equity can be measured in a number of alternative ways. In this study we consider two possibilities: first, capital gains on assets held by the firm may be regarded as transitory so that return to equity and the price of capital services should be measured excluding capital gains; secondly, capital gains on assets may be regarded as part of the return to investment so that return to equity and the price of capital services should include capital gains. We refer to the theory of investment behavior incorporating capital gains as Neoclassical I and the theory excluding capital gains as Neoclassical II. These two theories of investment behavior, differing in their treatment of the cost of capital but based on optimal capital accumulation, complete the list of five alternative explanations of investment behavior to be included in our comparison.

To summarize: We compare the following alternative theories of investment behavior: Neoclassical, Accelerator, Expected Profits, and Liquidity. These theories have been tested on widely varying bodies of data for different time periods and for different specifications of the time structure of investment behavior. Koyck has demonstrated the importance of the lag structure between changes in desired capital and the actual level of capital stock. To evaluate alternative theories of investment behavior it is essential to choose a lag structure that is appropriate for each theory and to compare the resulting explanations of investment expenditures. We take the flexible accelerator model as a point of departure for our study; we assume that replacement is proportional to capital stock. The alternative theories of investment behavior differ in specification of the desired level of capital. Given a proper specification of the lag structure for each theory, we are able to discriminate among the alternative specifications of desired capital and thereby among alternative theories of investment behavior.

In the following section we describe the basic flexible accelerator model in more detail and generalize it to permit a wider range of alternative lag structures. In section II we describe the measurement of variables that enter into the Accelerator, Liquidity, Expected Profits, and Neoclassical theories of investment behavior. We then turn to the empirical results. Explanations of investment behavior based on each of the alternative theories are compared for each of the corporations included in our sample. The relative performance of the alternative explanations is assessed. We conclude with the implications of our study for the theory of investment and, more generally, for the theory of the firm.

<sup>16</sup> See Modigliani and Miller [39].

### I. Framework of the Study

The studies of Accelerator, Expected Profits, and Liquidity theories of investment behavior by Grunfeld and Kuh are based on the flexible accelerator mechanism. While this mechanism represents a considerable generalization of the rigid accelerator, the resulting empirical characterization of the time structure of investment behavior is implausible. Kuh finds that the average lag between changes in desired capital and actual expenditures ranges from five to ten years or more.<sup>17</sup> Similar results were obtained by Grunfeld<sup>18</sup> and Koyck.<sup>19</sup> These results conflict sharply with survey results for new manufacturing plants obtained by Mayer [35]. Mayer finds that the average time required from the decision to undertake investment to the completion of construction is less than two years.<sup>20</sup> Using a generalization of Koyck's distributed lag function, Jorgenson and Stephenson [26] have corroborated Mayer's survey results. For manufacturing and its subindustries they obtain average lags between changes in desired capital and actual expenditures ranging from a year and a half to three years.<sup>21</sup> These results suggest that a generalization of the flexible accelerator mechanism is required for a valid comparison among alternative theories of investment behavior.

In the original flexible accelerator model (2) actual capital may be represented as a weighted average of all past levels of desired capital with geometrically declining weights. To generalize this assumption we let  $\mu_\tau$  be the weight of desired capital of period  $t-\tau$  in determining the level of actual capital in period  $t$ , obtaining the distributed lag function,

$$(5) \quad K_t = \sum_{\tau=0}^{\infty} \mu_\tau K_{t-\tau}^*$$

In this version of the distributed lag function the weights are non-negative and sum to unity,

$$\mu_\tau \geq 0, \quad (\tau = 0, 1 \dots),$$

$$\sum_{\tau=0}^{\infty} \mu_\tau = 1.$$

The weights appropriate for the original flexible accelerator decline geometrically,

$$\mu_\tau = (1 - \lambda)\lambda^\tau, \quad (\tau = 0, 1 \dots).$$

<sup>17</sup> Kuh [30, pp. 293-302].

<sup>18</sup> See Grunfeld [17].

<sup>19</sup> Koyck [29, pp. 74-110].

<sup>20</sup> See Mayer [35].

<sup>21</sup> Jorgenson and Stephenson [26, Table 2, pp. 21-22].

To generalize the flexible accelerator mechanism we first difference both sides of the distributed lag function (5),

$$K_t - K_{t-1} = \sum_{\tau=0}^{\infty} \mu_{\tau} [K_{t-\tau}^* - K_{t-\tau-1}^*],$$

and add the model of replacement (3),

$$I_t - \delta K_{t-1} = \sum_{\tau=0}^{\infty} \mu_{\tau} [K_{t-\tau}^* - K_{t-\tau-1}^*],$$

so that,

$$(6) \quad I_t = \sum_{\tau=0}^{\infty} \mu_{\tau} [K_{t-\tau}^* - K_{t-\tau-1}^*] + \delta K_{t-1}.$$

To complete the theory of investment behavior we must adopt a specification of the desired level of capital; we combine the generalized accelerator mechanism with each of the five alternative specifications of the desired level of capital described in the preceding section.

To estimate the parameters of a theory of investment behavior based on the generalized accelerator mechanism (6) the sequence of weights  $\{\mu_{\tau}\}$  must be approximated by a sequence generated by a finite number of parameters. In the Chenery-Koyck model the weights decline geometrically; Solow [48] has proposed that the weights be taken to correspond to the Pascal probability distribution. Jorgenson [24] has proposed a class of distributed lag functions based on the general Pascal probability distribution. This class of distributed lag functions includes those of Koyck and Solow as special cases; an arbitrary distributed lag function may be approximated to any desired degree of accuracy by a member of this class.<sup>22</sup> To compare alternative theories of investment behavior we must discriminate among alternative specifications of desired capital. Misspecification of the lag distribution for a given theory of investment behavior may bias the results of our comparison. Accordingly, we choose the best lag distribution for each alternative specification of desired capital from among the class of general Pascal distributed lag functions. Differences in the resulting explanations of investment behavior may then be attributed to the specification of the desired level of capital rather than to the specification of the lag distribution.

In the final form<sup>23</sup> of the general Pascal distributed lag function, gross

<sup>22</sup> Jorgenson [24, pp. 137-42].

<sup>23</sup> In the final form of a general Pascal distributed lag function, the function is written with a finite number of lags in both dependent and independent variables. For further details, see Jorgenson [24, p. 138].

investment is a function of changes in desired capital, lagged values of net investment and the level of capital stock. As an example, suppose that the best lag distribution requires current and lagged changes in desired capital and lagged net investment; the final form of the distributed lag function may be written,

$$I_t = \gamma_0[K_t^* - K_{t-1}^*] + \gamma_1[K_{t-1}^* - K_{t-2}^*] - \omega_1[I_{t-1} - \delta K_{t-2}] + \delta K_{t-1}.$$

Under the Accelerator theory of investment behavior desired capital is proportional to output,

$$K_t^* = \alpha Q_t,$$

where  $\alpha$  is the desired capital-output ratio. For the lag specification we have given, the complete Accelerator theory of investment behavior may be written,

$$I_t = \alpha\gamma_0[Q_t - Q_{t-1}] + \alpha\gamma_1[Q_{t-1} - Q_{t-2}] - \omega_1[I_{t-1} - \delta K_{t-2}] + \delta K_{t-1},$$

where the parameters— $\alpha$ ,  $\gamma_0$ ,  $\gamma_1$ ,  $\omega_1$ ,  $\delta$ —are estimated from data on output, capital stock, and investment expenditures. Since the weights in the distributed lag function must sum to unity, the coefficients of this function must satisfy,<sup>24</sup>

$$\gamma_0 + \gamma_1 = 1 + \omega_1.$$

This restriction enables us to estimate the parameters— $\alpha$ ,  $\gamma_0$ ,  $\gamma_1$ ,  $\omega_1$ —from estimates of  $\alpha\gamma_0$ ,  $\alpha\gamma_1$  and  $\omega_1$ . The rate of replacement may be estimated directly in calculating capital stock; as a check on the results, the rate of replacement may also be estimated as the coefficient of capital stock.

To estimate the parameters of the distributed lag function for each theory of investment behavior, an error term must be added to the final form of the distributed lag function as given above. We adopt the specification that the error term is distributed independently on successive observations with zero mean and constant variance. This specification has been employed by Chenery, Grunfeld, Jorgenson and Stephenson; and Kuh in studies based on the flexible accelerator mechanism and its generalization. Letting  $\{\epsilon_t\}$  denote the sequence of random errors, we assume that:

$$E(\epsilon_t) = 0, \quad V(\epsilon_t) = \sigma^2, \quad (t = 1 \dots n),$$

where  $\sigma^2$  is a constant, and:

$$C(\epsilon_t, \epsilon_{t-\tau}) = 0, \quad (t, t - \tau = 1 \dots n; \tau \neq 0).$$

Gross investment has considerable serial correlation due to the con-

<sup>24</sup> Jorgenson [24, p. 147].

tinuity of investment programs internal to the firm, the effects of the business cycle, and the possibility of trends in investment expenditures. It might be argued that the "true" disturbances in the explanation of investment behavior are also serially correlated. This view is deficient for the following reasons. First, all variables are deflated in order to remove the influence of common price trends; secondly, the investment series is in the main a first difference series so that trends in the underlying capital stock data are largely eliminated; finally, any remaining trend in the observations on investment may be explained by rising replacement requirements as represented by the capital stock variable. The distributed lag function itself fully accounts for serial correlation in the dependent variable since investment is represented as a weighted average of past changes in desired capital. Errors in the explanation may be accounted for by random variations in forces that are independent of the process translating changes in desired capital into actual investment expenditures.

Given a correct specification of the lag structure between changes in desired capital and actual investment expenditures, time series data for industry aggregates do not provide sharp discrimination among alternative explanations of investment behavior. Griliches and Wallace [16] have compared models similar to our Expected Profits and Neoclassical II models using quarterly time series for all of manufacturing. While the Neoclassical model is superior to the Expected Profits model on the basis of their empirical results, both models perform well.<sup>25</sup> On the basis of data for individual firms Grunfeld and Kuh were able to discriminate between the Liquidity model and the Expected Profits and Accelerator models. Accordingly, we employ data on the investment behavior of individual firms as the basis for our comparison of alternative theories. Data on individual firms have been analyzed through both time series and cross section models. The study of Meyer and Kuh [17] relied primarily on cross sections. Kuh has shown that cross sections for successive years do not provide a stable explanation of investment behavior. The intercepts for cross sections exhibit a strong pattern of cyclical variation, suggesting that the dynamic specification of the models used for cross sections is incorrect.<sup>26</sup> Kuh also rejects the hypothesis that the parameters of successive cross sections are the same.<sup>27</sup> In order to specify the lag structure correctly we concentrate on time series data for individual firms. We do not assume that parameters for all firms are the same for cross sections at a given point in time. Our results are thus free of biases that could result from inappropriate assumptions about the homogeneity of investment behavior across firms

<sup>25</sup> Griliches and Wallace [16, esp. p. 325].

<sup>26</sup> Kuh [30, p. 330].

<sup>27</sup> See Kuh [30, esp. Ch. 5, pp. 116-57].

in cross sections. We do not assume that the parameters are the same for different firms. The framework of our study is similar in this respect to that of Grunfeld. Our results are free of biases that could result from aggregation across firms in time series for industry groups. In a subsequent paper we will study possible sources of aggregation bias in distributed lag functions estimated from data on industry groups.

To summarize: In order to provide better discrimination among alternative theories of investment behavior our comparison is based on observations for individual firms rather than for industry aggregates. We determine an appropriate lag specification for each firm under each alternative specification of the desired level of capital stock. Each theory of investment behavior is based on a generalized accelerator mechanism and on the assumption that replacement investment is proportional to capital stock. Alternative theories differ in the specification of desired levels of capital stock. To compare alternative theories we first select the best lag distribution for each firm under each specification of desired capital among the class of general Pascal distributed lag functions. Our results are free of biases that could result from misspecification of the lag distribution or from inappropriate assumptions about the homogeneity of investment behavior across firms.

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## II. *Measurement*

The purpose of this section is to describe the accounting measurements that underlie our empirical evaluation of alternative theories of investment behavior. To provide a valid comparison among alternative explanations of investment expenditures the variables that enter each of the competing theories must be measured with as much precision as accounting data permit. For each firm the data must be available on a consistent basis over a substantial period of time. All firms whose stock is traded publicly have had to file annual reports with the Securities and Exchange Commission since 1934. These annual reports, consisting of complete income and balance sheet statements, are published in *Moody's Industrial Manual* [44] for the larger corporations. It was impossible to include firms in our sample that lost their identity through mergers during the period since 1934. Firms that shifted fiscal accounting years or changed their practices in the consolidations of accounting reports also failed to satisfy the criteria for inclusion in our sample. Limitations in the availability of detailed accounting data resulted in concentration on larger firms. A second justification for concentration on larger firms is the importance of their activity. At least two of the firms in our sample have investment programs that rival those of entire industry groups as reported in the Office of Business Economics (OBE) and Securities and Exchange Commission (SEC) Quarterly Investment Survey [54]. In any case primary interest is in the investment ac-



tivity of the individual corporation. Stochastic elements in the empirical investment functions are to be attributed to variations in the behavior of individual firms rather than to sampling variation.

In order to provide a wide range of industrial activity, we chose a sample of fifteen firms from the *Fortune* Directory of the 500 largest United States industrial corporations for 1962, using the industrial classification of the OBE-SEC Investment Survey in the selection of individual firms. The firms are selected from 14 different OBE-SEC industry groups. The only industry group not represented is Textiles. In many cases the largest firm in the OBE-SEC industry group was selected. In some cases appropriate data were not available for the largest firm; we then attempted to compile data for the second largest firm, and so on. Although all the firms included in our sample are large, there is considerable variation among them as to size and rate of growth. The firms included are listed in Table 1; the average amount of investment and the capital stock of each firm are given in the table along with the OBE-SEC industry classification of the firm. The average rate of investment in the postwar period for the firm with the largest level of investment activity, General Motors, was 200 times the rate for the firm with the smallest level, Westinghouse Air Brake. Capital stock for the firm with largest net fixed assets in 1961, Standard Oil of New Jersey, was approximately 160 times the capital stock of Westinghouse Air Brake. IBM, the firm with the most rapid rate of growth, had capital stock in 1961 twelve times larger than its 1937 capital stock. At the other extreme, Anaconda Company's 1961 capital stock declined in size by a third from the 1937 level. While it must be emphasized that our sample of firms should not be considered a probability sample of large United States corporations, the sample provides sufficient heterogeneity to serve as an adequate test of alternative theories of investment behavior. A larger sample would have made it difficult for us to give proper attention to compilation of accurate and consistent data for each individual firm. Of course, considerable care should be taken in extrapolating the results of the present study to small firms or to closely held corporations.

Turning to the measurement of individual variables, we give a brief outline of the procedure followed for deriving each variable from accounting reports for an individual corporation. The dependent variable, gross investment, denoted  $I_t$ , is the current value of investment in plant and equipment deflated by the investment goods price index for manufacturing, denoted  $q_t$ , to obtain the value of investment in constant dollars of 1954. The gross investment data are obtained from Form 10K reports of companies registered with the Securities and Exchange Commission as reported in *Moody's Industrial Manual*. These data are

TABLE I

Firm	Average Amount of In- vestment <sup>a</sup>	Capital Stock <sup>b</sup>	OBE-SEC Industry
General Motors	.7670	3.1225	Motor Vehicles and Equipment
Goodyear Tire and Rubber	.0554	.3616	Rubber Products
American Can	.0414	.5374	Other Durables
Pittsburgh Plate Glass	.0345	.3128	Stone, Clay, and Glass
United States Steel	.2980	2.9437	Primary Iron and Steel
General Electric	.1190	.7247	Electrical Machinery and Equip- ment
Reynolds Tobacco	.0127	.1267	Other Non-durables
Dupont	.1540	.9404	Chemicals and Allied Products
Anaconda Company	.0511	.7077	Primary Non-ferrous Metal
Standard Oil, N. J.	.6274	6.3560	Petroleum and Coal Products
International Paper	.0563	.4780	Paper and Allied Products
Westinghouse Air Brake	.0038	.0393	Transportation Equipment, ex- cluding Motor Vehicles
International Business Machines	.1839	.9492	Machinery, except Electrical
Swift and Company	.0266	.2467	Food and Beverage
Westinghouse Electric	.0497	.3841	Electric Machinery and Equip- ment

Source: *Moody's Industrial Manual* [44].

<sup>a</sup> Mean annual gross investment for the postwar period, 1946-1963, in billions of 1954 dollars.

<sup>b</sup> End of year net fixed assets for 1961 in billions of 1954 dollars.

listed under additions at cost in *Moody's* and, following normal tax accounting procedure, include any additions which have an expected life of more than one year. Comparable data on investment are not available for the firms included in our sample for years earlier than 1934. The investment goods price index is based on the implicit deflators for structures and equipment from *U.S. Income and Output* [55] and *Business Statistics* [53]. Calculation of capital stock by the perpetual inventory method was not feasible. The method we employed was to select an initial and terminal date of net capital stock from each firm's

balance sheet reports. These benchmark figures were deflated by the National Industrial Conference Board [4-6] fixed capital stock deflators for the firms' industry group. These deflated stock figures were interpolated by gross investment in constant prices,<sup>28</sup> resulting in capital stock values for each year and an estimate of replacement in constant prices for each year.

The independent variables for alternative specifications of desired capital were measured as follows: The value of output, denoted by  $p_t Q_t$ , was measured by sales plus the change in inventory stock. Output in constant dollars of 1954, denoted  $Q_t$ , was measured by the value of output deflated by the Wholesale Price Index [56] of the firm's industry group, denoted  $p_t$ . A more accurate measure of output would be sales plus the change in finished goods inventory. Unfortunately, a breakdown of inventory into finished goods, goods in process, and raw materials was not available for all firms. In the Accelerator theory of investment behavior desired capital is assumed to be proportional to output,

$$\text{Accelerator: } K_t^* = \alpha Q_t,$$

where  $\alpha$  is the desired capital-output ratio.

Internal funds available for investment expenditures are measured by profits after taxes plus depreciation less dividends paid. This liquidity measure was converted into constant prices of 1954 by dividing the current value of internal funds by the investment goods price index,  $q_t$ . The resulting measure of liquidity, denoted  $L_t$ , was suggested as the appropriate measure by Kuh on the grounds that the effects of liquidity can be distinguished from those of output while expected profits as measured by profits after taxes cannot be distinguished from output. Since changes in desired capital are employed to explain investment for changes in capacity with replacement accounted for separately, an alternative liquidity measure would be to subtract replacement in constant prices from the liquidity measure suggested by Kuh. A trial of this measure for several firms gave nearly the same results as those for the liquidity variable suggested by Kuh.<sup>29</sup> In the Liquidity theory of investment behavior, desired capital is proportional to liquidity,

$$\text{Liquidity: } K_t^* = \alpha L_t,$$

<sup>28</sup> Further details on this and other measurements are contained in the Statistical Appendix to a more extensive version of this paper available from the authors.

<sup>29</sup> Kuh [30, pp. 63 and 208-9]. A number of *ad hoc* liquidity measures were employed at the experimental stages of this study. In addition sales was used in place of output. The results were not materially different from those reported here.

unity, this is necessarily less than the equilibrium ratio  $k_1$  that would be determined by the intersection of  $sf(k)$  with  $nk$  in the usual Solow barter model. [For the moment, the dotted curve  $\sigma f(k)$  should be ignored.] In Tobin's words, "equilibrium capital intensity is lower in the monetary model."<sup>5</sup>

On further reflection, however, this conclusion seems unreasonable. For if the sole result of introducing money into an economy were to reduce  $k$  and hence per capita output and consumption, why should it be introduced? Where are the vaunted advantages of a monetary economy?

This paradox leads us to the observation that though equation (3) does describe a positive demand for real money balances, the preceding model does not really provide a rationale for the holding of these balances. For such a rationale must interpret money balances either as a consumer's good or as a producer's good.<sup>6</sup> In the first case, the services rendered by money balances should appear in the individual's utility function and hence in his (imputed) disposable income; whereas in the second they should reflect themselves in the production function. Neither of these approaches, however, is reflected in the preceding model. For on the one hand, its production function is the same as that of a barter economy; while on the other, its definition of disposable income includes only the actual increase in the real value of cash balances, not the imputed value of their liquidity services. Thus the foregoing model is not really consistent with the existence of money.

## II. *Money as a Consumer's Good*

3. Let us now see how these difficulties are obviated by treating money as a consumer's good. Conceptually, this means that money enters the utility function and its imputed services are included in disposable income. In accordance with the principles of welfare economics, these services must clearly be valued at the alternative cost at the margin of holding money balances which, as shown in the preceding section, is the money rate of interest, or  $r + \pi$ . The relevant definition of disposable income is then

$$\begin{aligned} (5) \quad Y_D &= Y + \frac{M}{p} (\mu - \pi) + \frac{M}{p} (r + \pi) \\ &= Y + \frac{M}{p} (\mu + r), \end{aligned}$$

<sup>5</sup> [22, p. 71].

<sup>6</sup> Cf. Patinkin [14, pp. 146-47]. An attempt to clothe this somewhat formalistic statement with more economic meaning is provided [14, pp. 79-80, 117-19, 147-48, and 154]. Cf. also the beginning of Sec. 10 below.

From balance sheet data we were able to obtain data on the value of depreciable and depletable assets and the value of inventories and cash plus accounts receivable. We derived an expression for the price of capital services for each of the four classes of assets, using the formula given above with appropriate specializations; for example, for nondepreciable assets, the rate of replacement,  $\delta$ , is zero. The price of capital services for each asset class depends on the cost of capital; given the fact that gross business income is the sum of the values of capital services, we were able to solve for the cost of capital. Two formulations were employed: First, the cost of capital was taken to be profits after taxes plus depreciation for tax purposes less depreciation at current replacement cost plus accrued capital gains on depreciable assets, depletable assets, and inventories, all divided by the market value of the firm in current prices. Secondly, the cost of capital was measured excluding all accrued capital gains.

For all firms included in the sample interest payments deducted for tax purposes were negligible so that we excluded them from gross business income in both measures of the cost of capital. Similarly, realized capital gains on assets were essentially zero for depreciable and depletable assets. For a number of firms capital gains on inventories are included in recorded profits. This is especially true for firms pricing ending inventory stock on the FIFO (first-in, first-out) method. For the firms using FIFO methods no adjustment of recorded profits for capital gains was made; this practice was also followed for firms following average-cost pricing of ending inventories. Profits were adjusted for inventory capital gains for firms that employed LIFO (last-in, first-out) inventory pricing.<sup>31</sup> In the first version of the neoclassical theory, capital gains are assumed to be taken into account in investment decisions; desired capital is proportional to the value of output divided by the price of capital services including capital gains,

$$\text{Neoclassical I: } K_t^* = \alpha \frac{p_t Q_t}{c_t},$$

$$c_t = \frac{q_t}{1 - u_t} \left[ (1 - u_t w_t) \delta + r_t - \frac{q_t - q_{t-1}}{q_t} \right],$$

where  $\alpha$  is the elasticity of output with respect to capital input. In the second version of the neoclassical theory, capital gains are assumed to be transitory; they are ignored in assessing the appropriate cost of capital for investment decisions and in the price of capital services; desired capital stock is again proportional to the value of output divided by the price of capital services,

<sup>31</sup> Further details are given in the Statistical Appendix; see footnote 28 above.

$$\text{Neoclassical II: } K_t^* = \alpha \frac{p_t Q_t}{c_t}, \quad c_t = \frac{q_t}{1 - u_t} [(1 - u_t w_t) \delta + r_t],$$

where, as before,  $\alpha$  is the elasticity of output with respect to capital and the price of capital services and cost of capital are measured with capital gains set equal to zero.<sup>32</sup>

### III. *Empirical Results*

To provide a basis for comparing alternative theories of investment behavior, we first determine an appropriate specification of the lag between changes in desired capital and investment expenditures under each specification of desired capital. We choose the best lag distribution for each firm from among the class of general Pascal distributed lag functions. In each case the appropriate specification of the distributed lag function is selected from those with current and two lagged changes in desired capital and two lagged values of net investment. These limitations are not very restrictive since annual data are employed for each firm. A very large variety of alternative lag distributions can be represented in this way, including the geometric distribution proposed by Koyck. Changes in desired capital and lagged net investment were allowed to enter the distributed lag function so long as they lowered the residual variance around the regression. The final set of values of current and lagged changes in desired capital and lagged net investment gives the minimum residual variance subject to the restrictions we have indicated. Given the best specification of the generalized accelerator mechanism for each alternative specification of desired capital, we can compare alternative theories of investment behavior with regard to their ability to explain the investment activity of corporations.<sup>33</sup>

To illustrate the empirical results, we consider the fitted distributed lag functions for General Motors as an example. For the Neoclassical I theory of investment, desired capital stock is proportional to the value of output,  $p_t Q_t$ , divided by the price of capital services,  $c_t$ , including capital gains. For the postwar period the form of the distributed lag function selected for General Motors includes current and lagged changes in desired capital and lagged net investment. The final form of the distributed lag function may be written,

<sup>32</sup> Further details are given in the Statistical Appendix; see footnote 28 above.

<sup>33</sup> Distributed lag functions were fitted to data for the postwar period, 1949-63, and to the postwar and prewar period, 1937-41 and 1949-63, combined. For purposes of policy and prediction the explanation of investment behavior under postwar conditions is most relevant and only results for the postwar period are discussed below. The results for the combined period are very similar to those for the postwar period. Detailed results of the regressions for each firm for all alternative theories of investment behavior for both time periods are given in a more extensive version of this paper; see footnote 28 above.

$$I_t = \beta + \alpha\gamma_0 \left[ \frac{p_t Q_t}{c_t} - \frac{p_{t-1} Q_{t-1}}{c_{t-1}} \right] + \alpha\gamma_1 \left[ \frac{p_{t-1} Q_{t-1}}{c_{t-1}} - \frac{p_{t-2} Q_{t-2}}{c_{t-2}} \right] \\ - \omega_1 [I_{t-1} - \delta K_{t-2}] + \delta K_{t-1}.$$

Substituting estimated numerical values for the unknown parameters into the distributed lag function, we obtain:

$$I_t = .2449 + \frac{.0160}{(.0063)} \left[ \frac{p_t Q_t}{c_t} - \frac{p_{t-1} Q_{t-1}}{c_{t-1}} \right] + \frac{.0150}{(.0066)} \left[ \frac{p_{t-1} Q_{t-1}}{c_{t-1}} - \frac{p_{t-2} Q_{t-2}}{c_{t-2}} \right] \\ + \frac{.3444}{(.2061)} [I_{t-1} - \delta K_{t-2}] + \frac{.1794}{(.0540)} K_{t-1}.$$

For the Neoclassical II theory of investment, desired capital is analogous to that in Neoclassical I, except that capital gains are set equal to zero for the price of capital services and the cost of capital. For the postwar period the form of the distributed lag function selected for General Motors includes three values of change in desired capital and two lagged values of net investment. The estimated distributed lag function with numerical values substituted for the unknown parameters is:

$$I_t = .1231 + \frac{.0411}{(.0094)} \left[ \frac{p_t Q_t}{c_t} - \frac{p_{t-1} Q_{t-1}}{c_{t-1}} \right] + \frac{.0654}{(.0105)} \left[ \frac{p_{t-1} Q_{t-1}}{c_{t-1}} - \frac{p_{t-2} Q_{t-2}}{c_{t-2}} \right] \\ + \frac{.0202}{(.0089)} \left[ \frac{p_{t-2} Q_{t-2}}{c_{t-2}} - \frac{p_{t-3} Q_{t-3}}{c_{t-3}} \right] + \frac{.3732}{(.1311)} [I_{t-2} - \delta K_{t-3}] \\ + \frac{.1826}{(.0361)} K_{t-1}.$$

In the Accelerator theory of investment, desired capital is proportional to output,  $Q_t$ . The best distributed lag function for General Motors includes lagged change in desired capital and lagged net investment. The final form of the distributed lag function may be represented as,

$$I_t = \beta + \alpha\gamma_1 [Q_{t-1} - Q_{t-2}] - \omega_1 [I_{t-1} - \delta K_{t-2}] + \delta K_{t-1}.$$

Substituting the estimated numerical values into the distributed lag function, we have:

$$I_t = .1963 + \frac{.0666}{(.0327)} [Q_{t-1} - Q_{t-2}] + \frac{.4780}{(.2115)} [I_{t-1} - \delta K_{t-2}] + \frac{.1878}{(.0593)} K_{t-1}.$$

Similarly, for the Expected Profits theory of investment, desired capital is proportional to the market value of the firm,  $V_t$ . The best distributed lag function for General Motors includes current and lagged changes in

desired capital and no lagged values of net investment. The final form of the distributed lag function is:

$$I_t = \beta + \alpha\gamma_0[V_t - V_{t-1}] + \alpha\gamma_1[V_{t-1} - V_{t-2}] + \delta K_{t-1}.$$

Substituting the numerical values, the estimated distributed lag function becomes:

$$I_t = .2793 + \frac{.0858}{(.0267)}[V_t - V_{t-1}] + \frac{.0610}{(.0268)}[V_{t-1} - V_{t-2}] + \frac{.1493}{(.0571)}K_{t-1}.$$

For the Liquidity theory of investment behavior the best distributed lag function includes current and lagged changes in desired capital and lagged net investment; after appropriate substitutions, we obtain.

$$I_t = .2345 + \frac{.3032}{(.2710)}[L_t - L_{t-1}] + \frac{.4941}{(.2743)}[L_{t-1} - L_{t-2}] \\ + \frac{.3989}{(.2279)}[I_{t-1} - \delta K_{t-2}] + \frac{.1712}{(.0620)}K_{t-1}.$$

We have determined the best specification of the distributed lag between changes in desired capital and investment expenditures for each of 5 alternative theories of investment behavior and for each of 15 corporations included in our sample. We can compare the alternative specifications of desired capital with respect to the explanation of investment behavior for the 15 corporations. The relative performance of the alternative specifications provides our criterion for comparison of alternative theories of investment behavior. Relative performance may be measured in many ways. The best measure of performance is the residual variance for the best fitted distributed lag function corresponding to each theory. The theory of investment behavior that results in the least residual variance provides the best explanation of investment behavior. Performance as measured by residual variance can usefully be supplemented by an analysis of the fitted coefficients. The coefficients associated with changes in desired capital are of particular interest. Without these terms, the fitted distributed lag functions contain only lagged net investment and capital stock, so that the resulting explanation of investment expenditures cannot be attributed to a theory of investment behavior. Finally, an alternative measure of goodness of fit based on the qualitative characteristics of the fitted distributed lag functions is the number of "right" and "wrong" changes in direction for the fitted values of investment by comparison with the actual values.

First, we consider the number and significance of coefficients of changes in desired capital stock entering each fitted distributed lag function. A summary of the evidence is provided by Table 2. The first half of the table gives the number of coefficients of changes in desired



capital that enter the fitted distributed lag functions for all firms. In selecting an appropriate form for the lag distribution, a value of change in desired capital was allowed to enter the regression if it lowered the residual variance around the regression. The column labeled  $X_2$  gives the number of values of current changes in desired capital for all firms, the column  $X_3$  the number of lagged changes in desired capital, and the column  $X_4$  the number of changes in desired capital lagged twice. The second half of the table presents the number of coefficients of changes in desired capital stock whose fitted values are twice their estimated standard errors or more. For example, in the fitted distributed lag functions for the Neoclassical I theory of investment, 13 of a possible 15 coefficients of current changes in desired capital enter the regressions. Of these, 10 have coefficients that are twice their standard errors or more. For this same theory, 12 of a possible 15 coefficients of lagged changes in desired capital enter the regressions; 6 of 15 coefficients of changes in desired capital lagged twice enter these regressions. The total number of coefficients for all lags and all firms is 31, or an average of slightly over two per firm; the total number of these coefficients twice their standard errors or more is 20 or between one and two per firm.

The tabulation of coefficients given in Table 2 supports the following conclusions: First, the Neoclassical I theory of investment, including capital gains in the price of capital services and the cost of capital, has the largest number of coefficients entering the fitted distributed lag functions and the largest number of coefficients twice their standard errors or more. The Neoclassical II theory of investment, excluding capital gains, has the second largest number of coefficients in both

TABLE 2

Model	1949-1963			
	$X_2$	$X_3$	$X_4$	Total
Number of Desired Capital Stock Coefficients				
Neoclassical I	13	12	6	31
Neoclassical II	14	10	4	28
Accelerator	9	9	1	19
Expected Profits	13	7	3	23
Liquidity	4	8	2	14
Number of Coefficients Twice Their Standard Errors				
Neoclassical I	10	8	2	20
Neoclassical II	10	7	1	18
Accelerator	5	6	0	11
Expected Profits	9	6	1	16
Liquidity	1	4	1	6

groups. The Accelerator and Expected Profits theories of investment stand next in order of the number of coefficients entering the fitted distributed lag functions and the number of coefficients that are twice their standard errors or more. The Expected Profits theory has a large number of coefficients in each category. The Liquidity theory of investment has fewer coefficients entering the fitted distributed lag functions than any other theory and fewer coefficients twice their standard errors or more. Only 14 changes in desired capital enter the fitted regressions or less than one per firm. Only six of these coefficients are twice their standard errors or more.

We turn next to the direct measurement of the relative performance of the alternative theories of investment in the explanation of corporate investment behavior. As a standard for evaluation of the performance of all models, we have fitted a "naive" model to the same data. This naive model is the best autoregressive scheme for investment; as many as three lagged values of investment are allowed to enter so long as they reduce the residual variance around the fitted autoregression. The naive model may be written,

$$I_t = \beta_0 + \beta_1 I_{t-1} + \beta_2 I_{t-2} + \beta_3 I_{t-3}.$$

Goodness of fit statistics for all theories of investment behavior and for the naive model are given for each corporation included in our sample in Table 3. The coefficient of multiple determination,  $R^2$ , is given in the first column of this table; the standard error of the regression,  $s$ , is given in the second column; and the third column gives the Durbin-Watson ratio,  $d$ . The standard error of the regression is corrected for degrees of freedom while the coefficient of multiple determination is not. Accordingly, comparison of the relative performance of the different models is based on the standard error. For comparison of the various models on the basis of standard error the random error for the underlying distributed lag model must be serially independent. To provide some evidence on this assumption, we employ the Durbin-Watson statistic. This statistic is biased toward randomness when lagged values of net investment are included in the fitted distributed lag function.<sup>34</sup> However, this bias affects all the distributed lag functions equally so that values of the Durbin-Watson statistic provide useful information about the relative presence or absence of autocorrelation. Employing the tables of Durbin and Watson the hypothesis of randomness cannot be rejected in favor of either positive or negative autocorrelation for any model for any firm for any time period. This evidence points to lack of substantial serial correlation. The tabulation of goodness of fit statistics given in Table 3 reveals that for nearly every firm the fitted distributed lag functions were superior to the Naive Model on the basis

<sup>34</sup> See Griliches [15] and Malinvaud [34].

TABLE 3—GOODNESS OF FIT STATISTICS

Firm and Model	1949-1963			Firm and Model	1949-1963			Firm and Model	1949-1963		
	$R^2$	$s$	$d$		$R^2$	$s$	$d$		$R^2$	$s$	$d$
General Motors				General Electric				International Paper Company			
a. Neoclassical I	.70	.1765	2.03	a. Neoclassical I	.72	.0227	1.80	a. Neoclassical I	.74	.0105	2.01
b. Neoclassical II	.89	.1148	2.32	b. Neoclassical II	.85	.0173	1.37	b. Neoclassical II	.77	.0100	2.02
c. Accelerator	.62	.1920	2.21	c. Accelerator	.58	.0276	1.89	c. Accelerator	.66	.0121	1.72
d. Expected Profits	.64	.1852	1.36	d. Expected Profits	.71	.0244	2.27	d. Expected Profits	.72	.0109	1.39
e. Liquidity Model	.61	.2037	2.29	e. Liquidity Model	.71	.0240	2.58	e. Liquidity Model	.79	.0096	2.37
f. Naive Model	.47	.2072	2.22	f. Naive Model	.51	.0272	1.71	f. Naive Model	.14	.0177	1.79
Goodyear				Reynolds Tobacco				Westinghouse Air Brake Corp.			
a. Neoclassical I	.73	.0119	2.71	a. Neoclassical I	.85	.0040	2.20	a. Neoclassical I	.61	.00135	1.87
b. Neoclassical II	.66	.0127	2.14	b. Neoclassical II	.89	.0034	2.28	b. Neoclassical II	.84	.0009	1.76
c. Accelerator	.61	.0135	1.61	c. Accelerator	.92	.0028	1.98	c. Accelerator	.55	.0015	1.66
d. Expected Profits	.71	.0118	2.16	d. Expected Profits	.84	.0039	1.87	d. Expected Profits	.60	.00137	2.08
e. Liquidity Model	—*	—	—	e. Liquidity Model	.80	.0043	2.03	e. Liquidity Model	.57	.0016	1.71
f. Naive Model	.38	.0157	2.02	f. Naive Model	.76	.0044	1.73	f. Naive Model	.19	.0018	2.01

American Can				Dupont				International Business Machine				Swift				Westinghouse Electric			
a. Neoclassical I	.66	.0087	2.21	a. Neoclassical I	.60	.0321	1.55	a. Neoclassical I	.93	.0271	1.27	a. Neoclassical I	.65	.0049	1.37	a. Neoclassical I	.64	.0125	2.06
b. Neoclassical II	.44	.0101	2.16	b. Neoclassical II	—*	—	—	b. Neoclassical II	.96	.0208	2.57	b. Neoclassical II	.53	.00543	1.83	b. Neoclassical II	.75	.0110	1.56
c. Accelerator	.39	.0105	1.73	c. Accelerator	.63	.0309	1.38	c. Accelerator	.95	.0218	2.53	c. Accelerator	—*	—	—	c. Accelerator	.58	.01289	1.64
d. Expected Profits	.27	.0110	2.15	d. Expected Profits	—*	—	—	d. Expected Profits	.89	.0313	1.91	d. Expected Profits	.59	.0051	1.60	d. Expected Profits	.57	.01293	1.70
e. Liquidity Model	—*	—	—	e. Liquidity Model	—*	—	—	e. Liquidity Model	.90	.0306	2.38	e. Liquidity Model	.49	.00538	1.59	e. Liquidity Model	.47	—	—
f. Naive Model	.04	.0121	1.76	f. Naive Model	.30	.0407	1.42	f. Naive Model	.89	.0324	1.90	f. Naive Model	.42	.0055	2.07	f. Naive Model	—*	—	1.78
Pittsburgh Plate Glass				Anaconda Company				Standard Oil, N. J.				Westinghouse Electric							
a. Neoclassical I	.72	.0089	2.16	a. Neoclassical I	.87	.0078	1.06	a. Neoclassical I	.86	.0736	2.48	a. Neoclassical I	.65	.0049	1.37	a. Neoclassical I	.64	.0125	2.06
b. Neoclassical II	.41	.0129	1.86	b. Neoclassical II	.78	.0102	1.65	b. Neoclassical II	.86	.0755	2.25	b. Neoclassical II	.53	.00543	1.83	b. Neoclassical II	.75	.0110	1.56
c. Accelerator	.51	.01178	2.36	c. Accelerator	.80	.0098	2.48	c. Accelerator	.69	.1083	1.79	c. Accelerator	—*	—	—	c. Accelerator	.58	.01289	1.64
d. Expected Profits	.45	.01180	1.91	d. Expected Profits	.87	.0084	2.83	d. Expected Profits	.75	.1022	2.24	d. Expected Profits	.59	.0051	1.60	d. Expected Profits	.57	.01293	1.70
e. Liquidity Model	—*	—	—	e. Liquidity Model	.85	.0080	1.98	e. Liquidity Model	.55	.1249	1.62	e. Liquidity Model	.49	.00538	1.59	e. Liquidity Model	.47	—	—
f. Naive Model	.30	.0127	1.83	f. Naive Model	.54	.0128	1.93	f. Naive Model	.50	.1258	1.67	f. Naive Model	.42	.0055	2.07	f. Naive Model	—*	—	1.78
U. S. Steel				Standard Oil, N. J.				Standard Oil, N. J.				Westinghouse Electric							
a. Neoclassical I	.51	.0801	1.46	a. Neoclassical I	.86	.0736	2.48	a. Neoclassical I	.86	.0736	2.48	a. Neoclassical I	.64	.0125	2.06	a. Neoclassical I	.64	.0125	2.06
b. Neoclassical II	.50	.0854	1.63	b. Neoclassical II	.86	.0755	2.25	b. Neoclassical II	.86	.0755	2.25	b. Neoclassical II	.75	.0110	1.56	b. Neoclassical II	.75	.0110	1.56
c. Accelerator	—*	—	—	c. Accelerator	.69	.1083	1.79	c. Accelerator	.69	.1083	1.79	c. Accelerator	.58	.01289	1.64	c. Accelerator	.58	.01289	1.64
d. Expected Profits	.69	.0676	1.42	d. Expected Profits	.75	.1022	2.24	d. Expected Profits	.75	.1022	2.24	d. Expected Profits	.57	.01293	1.70	d. Expected Profits	.57	.01293	1.70
e. Liquidity Model	.46	.0841	1.57	e. Liquidity Model	.55	.1249	1.62	e. Liquidity Model	.55	.1249	1.62	e. Liquidity Model	.47	—	—	e. Liquidity Model	.47	—	—
f. Naive Model	.39	.0818	1.70	f. Naive Model	.50	.1258	1.67	f. Naive Model	.50	.1258	1.67	f. Naive Model	.47	.0131	1.78	f. Naive Model	.47	.0131	1.78

\* No  $K_1$  variable reduces the standard error of the regression.

TABLE 4—MODEL RANKING ON MINIMUM RESIDUAL VARIANCE CRITERION, 1949-1963

Model \ Model	Neoclassical I	Neoclassical II	Accelerator	Expected Profits	Liquidity Model
Neoclassical I		8	12	12	14
Neoclassical II	7		11	9, tie	10, tie
Accelerator	3	4		6	10
Expected Profits	3	5, tie	9		10, tie
Liquidity Model	1	4, tie	5	4, tie	

of goodness of fit, except for the Liquidity theory of investment. The Liquidity theory is superior to the Naive Model for only 9 of the 15 firms. We conclude that the fitted distributed lag functions are superior to the naive models although the margin of superiority for the Liquidity theory of investment is rather narrow.

Our comparison of alternative theories of investment behavior is based on the criterion of minimum standard error for the fitted distributed lag functions. All possible two-way comparisons of the alternative theories are presented in Table 4. The numbers listed in each row give the number of firms out of 15 for which the theory listed at the left-hand side of the table has a lower standard error than the theory listed at the top of the table. As an example, the Accelerator theory has a lower standard error than Neoclassical I for 3 out of 15 firms; the Accelerator has a lower standard error than Neoclassical II for 4 out of 15 firms and a lower standard error than the Expected Profits theory for 6 out of 15 firms with 2 ties. Finally, the Accelerator theory has a lower standard error than the Liquidity theory for 10 out of 15 firms.

The tabulation presented in Table 4 supports the following ranking of the alternative theories of investment behavior: The Neoclassical I theory of investment, including capital gains in both the price of capital services and the cost of capital, is slightly superior to Neoclassical II theory, excluding capital gains. It is clearly superior to the Accelerator theory with a lower standard error for 12 of 15 firms. It is also superior to the Expected Profits theory with a lower standard error for 12 of 15 firms. Finally, Neoclassical I is superior to the Liquidity theory for 14 of 15 firms. Continuing the ranking, the Neoclassical II theory of investment behavior is superior to the Accelerator theory for 11 of 15 firms. It is superior to the Expected Profits theory for 9 of 15 firms with one tie. Finally, Neoclassical II is superior to the Liquidity theory for 10 of 15 firms with one tie. The Expected Profits theory is superior to the Accelerator theory for 9 of 15 firms. Expected Profits is superior to the Liquidity theory for 10 of 15 firms with one tie. Finally, the Accelerator theory is superior to the Liquidity theory for 10 of 15 firms

with one tie. We conclude that the alternative theories may be ranked as follows: (1) Neoclassical I; (2) Neoclassical II; (3) Expected Profits; (4) Accelerator; and (5) Liquidity.

Our first conclusion is that the Liquidity theory of investment can be dismissed from serious consideration as an explanation of corporate investment behavior. As one might suspect, financial constraints play a very minor role in the explanation of investment behavior for large firms. Our results strongly corroborate the previous findings of Grunfeld and Kuh. For eight corporations for the period 1935-54, Grunfeld found that the partial correlation between profits and investment given capital stock was insignificant for six of the eight corporations.<sup>35</sup> Four of the firms in Grunfeld's sample are included in our sample of fifteen firms so that the results are not completely independent. Nevertheless, the differences between the two studies are sufficiently great that the results can be taken to reinforce each other. Kuh's study is based on 60 corporations in the capital goods industry for the period 1935-56. None of the firms in Kuh's sample is included in our sample; furthermore, his sample is concentrated on firms that are considerably smaller than those we have analyzed. Kuh concludes that the results from time series fail to support the internal funds or profits model.<sup>36</sup>

Our second conclusion is that Expected Profits and Accelerator models perform about equally well. The results slightly favor the Expected Profits model. The goodness-of-fit comparison of the two theories is reinforced by the enumeration of the number of coefficients that enter the fitted distributed lag functions for each theory, presented in Table 2. Again, the results slightly favor the Expected Profits theory. Our findings reinforce and extend Kuh's identification of expected profits with the capacity utilization theory or accelerator. No doubt information about profit expectations may be obtained from stock market data; however, this same information is adequately represented by levels of output or sales. Just as changes in profits before and after taxes are determined primarily by sales changes, alterations in the market value of the firm are adequately accounted for, so far as the determination of investment behavior is concerned, by alterations in output levels. Expected profits, whether measured by realized profits or the market value of the firm, may be represented by output levels. We conclude that a theory of investment behavior based on profit expectations may be identified with the capacity utilization theory so far as empirical results are concerned.

Our final conclusion is that either of the versions of the neoclassical theory of investment behavior we have examined is clearly superior to

<sup>35</sup> Grunfeld [17, Table 3, p. 219].

<sup>36</sup> Kuh [30, p. 213]. See also, Eisner [8].

capacity utilization or profit expectations theories of investment. The neoclassical theory is far superior to internal funds theories of investment. Our findings thus corroborate the conclusions of Griliches and Wallace,<sup>37</sup> based on an analysis of quarterly time series data for all of manufacturing. Of course, our results provide a much sharper discrimination among alternative theories of investment behavior as our comparison of results from aggregate time series and time series for individual firms led us to expect. Between the two versions of the neoclassical theory of investment our results suggest that a better explanation of corporate investment behavior is provided by the Neoclassical I theory, incorporating capital gains in the price of capital services and the cost of capital. In any case the two theories are remarkably similar in performance. In a subsequent paper we will compare the results for these two theories in greater detail.

An alternative method for assessing the goodness of fit of the distributed lag functions corresponding to each theory of investment behavior is the number of "right" and "wrong" changes in direction for the fitted values of investment by comparison with the actual values. The number of correct changes in direction, the number of incorrect changes, and the number of extra turning points for the fitted values of investment are recorded in Table 5. Results are tabulated separately for peaks and troughs. The direction of change at a peak or trough is correct if the fitted value of investment at time  $t+1$  is less than the fitted value at time  $t$  for a peak of actual investment and greater than the value at time  $t$  for a trough. Where no changes in desired capital enter a fitted distributed lag function, results from the Naive Model are substituted for those of the distributed lag function.

On the basis of the number of correct turning points, the alternative theories may be ranked as follows: The Naive Model ranks last by a considerable margin on the turning point criterion. The Liquidity theory of investment ranks lowest among the alternative theories of investment behavior. Expected Profits and Accelerator theories have nearly identical performance on turning points. Neoclassical I theory is slightly superior to Neoclassical II and both have a better performance record than the Accelerator or Expected Profits theories. We conclude that the ranking produced by an examination of turning points is substantially the same as that produced by the criterion of minimum residual variance.

To summarize: We have compared alternative theories of investment behavior with regard to their ability to explain corporate investment behavior. Although the relative performance of the alternative theories may be measured in a number of ways, the three measures of relative

<sup>37</sup> Griliches and Wallace [16, p. 325].

TABLE 5—PREDICTION OF DIRECTION OF CHANGE OF INVESTMENT AT TURNING POINTS

Model			Totals	
			$P^a$	$T^b$
Neoclassical I	$R^c$		26	33
	$W^d$		13	8
	$E^e$		6	2
Neoclassical II	$R$		26	29
	$W$		13	12
	$E$		3	2
Accelerator	$R$		25	27
	$W$		14	14
	$E$		5	3
Expected Profits	$R$		26	26
	$W$		13	15
	$E$		4	4
Liquidity Model	$R$		16	18
	$W$		23	23
	$E$		7	3
Naive Model	$R$		7	12
	$W$		32	29
	$E$		5	1

<sup>a</sup> Peak.<sup>b</sup> Trough.<sup>c</sup> Right direction.<sup>d</sup> Wrong direction.<sup>e</sup> Extra turning points in regression prediction.

performance we have used—proportion of correct turning points, standard error of the regression, number of changes in desired capital entering the fitted distributed lag function—produce an almost identical ordering of alternative theories of investment behavior: (1) Neoclassical I; (2) Neoclassical II; (3) Expected Profits; (4) Accelerator; and (5) Liquidity. Our tests discriminate sharply among the Neoclassical theories and the Expected Profits and Accelerator theories and between these theories and the Liquidity theory. The discrimination between Neoclassical I and Neoclassical II theories, which differ in their treatment of capital gains realized on assets, is less sharp and deserves further examination.

#### IV. Conclusion

The purpose of our study has been to compare five alternative theories of investment behavior: Neoclassical I, including capital gains



on assets; Neoclassical II, excluding capital gains; Accelerator, based on output or capacity utilization; Expected Profits, based on the market value of the firm; and Liquidity or internal funds. The point of departure for our study is the flexible accelerator mechanism originated by Chenery and Koyck; we have generalized this mechanism in order to provide a wider range of possible time patterns for investment behavior. Due to the importance of correct specification of the lag structure underlying investment, we have determined the best distributed lag function for each alternative theory from the class of general Pascal distributed lag functions. To permit sharper discrimination among the alternative theories we have employed data for individual firms; we have selected the best lag distribution for each alternative theory for each of the firms included in our sample. Our results are free of biases that could result from misspecification of the lag structure or from inappropriate assumptions about the homogeneity of investment behavior across firms. To measure the relative performance of the alternative theories of investment behavior we have relied primarily on the criterion of minimum residual variance. This measure of performance has been supplemented by measures of the proportion of correct turning points and the number of changes in desired capital entering the fitted distributed lag functions. The three measures of relative performance produce essentially the same results.

Our principal conclusion is that the neoclassical theory of investment behavior is superior to theories based on capacity utilization or profit expectations and that these theories are superior, in turn, to a theory based on internal funds available for investment. The latter part of our conclusion corroborates the previous results of Grunfeld and Kuh. Both of the versions of the neoclassical theory we have examined—including or excluding capital gains realized on assets from the cost of capital and the price of capital services—provide a better explanation of corporate investment behavior than any of the competing theories. The neoclassical theory including capital gains appears to provide a somewhat better explanation of corporate investment behavior.

Our conclusions bear on broader issues in the theory of the firm. Meyer and Kuh have suggested as a possible basis for the theory of investment behavior the assumption that business firms maximize utility defined more broadly than in the characterization of the objectives of the firm in the neoclassical theory of optimal capital accumulation:

Partial recognition of institutional changes has led in recent years to shift the theory of the firm, and consequently of plant and equipment investment, from a profit maximization orientation to that of utility maximization. Primarily, this move represents a growing belief that

profit maximization is too narrow to encompass the full scope of modern entrepreneurial motives, particularly once the previously assumed objective conditions are released from *ceteris paribus*, and the theory seeks to explain a much wider range of behavior response.<sup>38</sup>

Similar views on the theory of the firm have been expressed by Machlup [33], Simon [47], and many others. Simon argues that: "... I should like to emphasize strongly that neither the classical theory of the firm nor any of the amendments to it or substitutes for it that have been proposed have had any substantial amount of empirical testing. If the classical theory appeals to us, it must be largely because it has a certain face validity ... rather than because profit maximizing behavior has been observed."<sup>39</sup> Simon ignores the entire econometric literature on cost and production functions, all of which is based on the neoclassical theory of the firm.<sup>40</sup> The evidence is so largely favorable to the theory that current empirical research emphasizes such technical questions as the appropriate form for the production function and the statistical specification for econometric models of production based on this theory. Simon's characterization of alternatives to the neoclassical theory of the firm is correct; this theory has not been subjected to substantial empirical testing. However, his characterization of the empirical evidence on the neoclassical theory is seriously incomplete.

Our results reinforce the evidence on the neoclassical theory of the firm from studies of cost and production functions. We conclude that the objections to the neoclassical theory of the firm as a basis for the theory of investment behavior by Meyer and Kuh are ill-founded. The appeal to a broader view of entrepreneurial objectives is not supported by evidence from econometric studies of cost and production functions or from studies of investment behavior. The neoclassical theory of the firm is more powerful than the broader view suggested by Machlup, Meyer and Kuh, and Simon in that a much narrower range of conceivable behavior is consistent with the neoclassical theory. On the basis of our comparison of alternative theories of investment behavior we conclude that further research can fruitfully incorporate precisely the factors central to the neoclassical theory of the firm. Although these factors played some role in early studies of investment behavior, they were not properly evaluated due to imprecise formulation of the theory of demand for capital services and due to misspecification of the time structure of investment behavior.

<sup>38</sup> Meyer and Kuh [37, p. 9].

<sup>39</sup> Simon [47, p. 8].

<sup>40</sup> A recent survey of the literature by Walters [52] enumerates 345 references, almost all presenting results of econometric tests of the neoclassical theory which are overwhelmingly favorable to the theory.

Obviously, our theory of corporate investment can be further improved. A more sophisticated analysis of the effects of tax policy on corporate investment behavior can be made.<sup>41</sup> Alternative approximations to the cost of capital for individual corporations are possible.<sup>42</sup> All the variables that enter the neoclassical theory of investment behavior can be measured more accurately.<sup>43</sup> All of these further improvements will require time and effort. Our conclusions suggest that this work is likely to be fruitful and that the time and effort required will be justified by the results.

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<sup>41</sup> See, for example, Hall and Jorgenson [18] [19]; their analysis has not yet been extended to the level of the individual corporation.

<sup>42</sup> For example, it might be useful to include "growth opportunities" in the measurement of the cost of capital, as recently suggested by Modigliani and Miller [43].

<sup>43</sup> Further suggestions for better measurement are given in the Statistical Appendix; see footnote 28 above.

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# THE ROLE OF MONEY IN A SIMPLE GROWTH MODEL

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Increasing attention has been devoted in the recent literature to the role of money in growth models. In Part I of this paper we shall summarize Tobin's basic analysis of this question.<sup>1</sup> We shall then show that this analysis is deficient in that it does not really assign a meaningful role to money—either as a consumer's or a producer's good. Parts II and III of the article then analyze models in which money is assumed to fulfill these respective functions. Part IV presents some concluding observations.

Our main concern in this paper will be with comparative dynamics: that is, with the analysis of the effects of different monetary policies on the steady-state or long-run-equilibrium properties of the model. We shall also briefly discuss the stability properties of the model, though only under additional simplifying assumptions

## *I. The Tobin Analysis*<sup>2</sup>

1. Consider a Solow [17] growth model with a linearly homogeneous production function  $Y = F(K, L)$ , where  $Y$ ,  $K$ , and  $L$  respectively represent net output, capital and (effective) labor. Dividing the production function through by  $L$ , yields the per capita or intensive form  $y = f(k)$ , where  $y = Y/L$  and  $k = K/L$ . As usual, assume that the

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<sup>1</sup> Tobin [21] [22]. Other contributions to this question have been made by Enthoven [3], Marty [11, pp. 56–59], Patinkin [14, Ch. XIV:5], Stein [18], and Johnson [7] [8]. The authors have also benefited from reading in mimeographed form Miguel Sidrauski's doctoral thesis, which has since been summarized in [15], as well as a paper of his which has since appeared in [16]. See also Mundell [12] [13].

<sup>2</sup> We make use here of Johnson's convenient presentation of the Tobin analysis in terms of an adapted Solow model. It should, however, be noted that—as Tobin [22] has already shown, and Johnson acknowledged [8]—Johnson's main conclusion, that money is neutral in the Tobin model, is incorrect; see footnote 14 below.

marginal product of capital is positive and diminishing; i.e.,  $f'(k) > 0$  and  $f''(k) < 0$ . Assume also that the (effective) quantity of labor grows exogenously at the constant per period rate of  $n$ .

Into this model Tobin introduces a government which spends a fixed proportion of the national income, and which finances this expenditure either by levying taxes or by printing money. For the purpose at hand, this is analytically equivalent to the simpler assumption (which we shall now use) that the sole function of the government is to issue paper money which it injects into the economy by means of transfer payments—or withdraws by means of taxes. These payments (or taxes) are assumed to be independent of the individual's holdings of money—so that they do not affect his decisions with respect to the level of these holdings. Note that, by definition, this money is of the outside type: that is, it represents the debt of a unit external to the private sector of the economy, and hence a net asset of this sector. We shall also assume that there are no direct storage costs of holding money. Similarly, as long as we shall deal with outside money, we shall assume that there are no costs of administering the monetary system.

The major path through which money affects the workings of the economy in the Tobin model is through its effect on the real disposable income which determines the consumption (or, equivalently, savings) behavior of the individuals. According to Tobin, this disposable income is now

$$(1) \quad Y_D = Y + \frac{d\left(\frac{M}{p}\right)}{dt} = Y + \frac{M}{p} (\mu - \pi),$$

where  $M$  represents the quantity of money supplied (and hence existing) in the system,  $p$  the price level,  $\mu = \dot{M}/M$  the rate of change of the money supply, and  $\pi = \dot{p}/p$  the rate of change of the price level. Thus real disposable income in this model is defined as real net national income ( $Y$ ) *plus* the real value of the increase in the nominal quantity of money ( $\mu M/p$ —which in turn represents the real value of the transfer payments actually made by the government) *less* the decrease in the real value of existing cash balances caused by a price increase ( $\pi(M/p)$ ).

Note that in order to maintain consistency of the national accounts in real terms, this definition of real disposable income makes it necessary to define the real deficit of the government as also equal to  $\mu(M/p) - \pi(M/p)$ ; for only then will it be true that (in real terms) savings = investment + government deficit. This means that, for example, the government will be recorded as incurring a real deficit even if it does not issue new money, but instead experiences an increase in the real value

of its outstanding debt in the form of money as a result of a price decline.

The model just described has two assets—physical capital and real money balances. The respective rates of return on these assets are  $r = \partial F(K, L) / \partial K = f'(k)$  and (by the assumption of zero storage costs)  $-\pi$ , where  $r$  is the real rate of interest, equal to the marginal productivity of capital, and  $-\pi$  is the rate of decrease of the price level.<sup>3</sup> In accordance with the usual approach of monetary theory, we shall also assume that there exist “market frictions” and/or uncertainties with respect to the timing of payments which generally cause individuals to hold a portfolio which consists of both of these assets. In deciding on the optimum composition of this portfolio, the individual is actually concerned with the *anticipated* rates of return from the two assets. For simplicity, however, we shall assume that these are always equal to the *existing* rates. In view of the greater liquidity of money balances, it then follows that equilibrium cannot prevail unless the yield from these balances is less than that on physical capital; i.e.,  $-\pi < r$ .

2. Assume now that individuals save a certain proportion,  $s$ , of their disposable incomes. Assume also that they hold a certain proportion,  $\lambda$ , of the national income,  $Y$ , in the form of real money balances (actually, Tobin assumes that the relevant variable here is physical capital,  $K$ ; this difference does not, however, affect the nature of the steady-state path); and that this proportion is inversely dependent on the anticipated alternative cost of holding these balances: i.e., on the difference between what could have been earned from the holding of a unit of physical capital and what will be earned from the holding of real money balances. By our assumption that anticipated and actual rates

<sup>3</sup> Note that  $-\pi$  is the rate of return per unit of time on a unit of *real* money balances. For consider an individual holding a given nominal quantity of money. The increase in his wealth generated by a price change is

$$d\left(\frac{M}{p}\right) = -\frac{M}{p^2} dp.$$

The corresponding increase in his wealth per unit of time (i.e., the increase in his income) is

$$\frac{d\left(\frac{M}{p}\right)}{dt} - \frac{M}{p^2} \frac{dp}{dt} = -\frac{M}{p} \pi.$$

Hence the increase per unit of real money balances (i.e., the rate of return on real balances) is

$$\frac{\frac{d\left(\frac{M}{p}\right)}{dt}}{\frac{M}{p}} = -\pi.$$



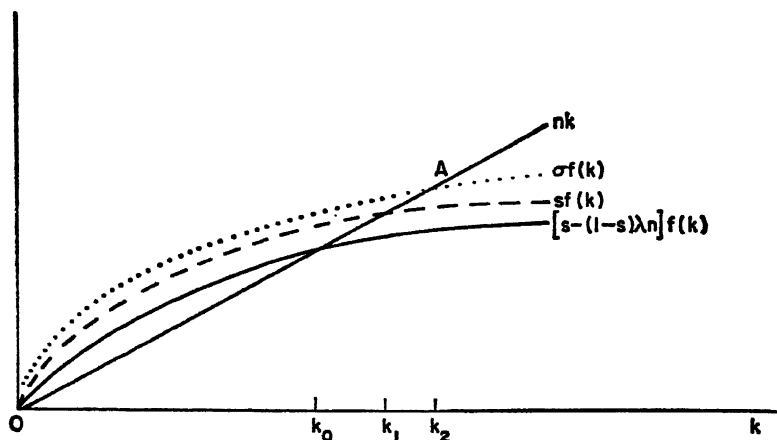


FIGURE 1

of return are equal, this cost is  $r - (-\pi) = r + \pi$ , or Fisher's money rate of interest. Thus we assume that  $\lambda = \lambda(r + \pi)$ , where  $\lambda'(\cdot)$  is assumed negative. As noted above, in any equilibrium situation we must have  $-\pi < r$ , which means that the money rate of interest must be positive.

The Tobin model is thus one in which the rate of capital accumulation is

$$(2) \quad \dot{K} = F(K, L) - (1 - s) \left[ F(K, L) + \frac{M}{p} (\mu - \pi) \right],$$

where the second term on the right-hand side represents the amount of commodities consumed. Under the assumption that the demand for real money balances

$$(3) \quad \frac{M^d}{p} = \lambda F(K, L)$$

is always equal to the supply  $M/p$  (an equality which we shall assume to be maintained by the instantaneous adjustment of the price level), Tobin shows that the steady-state value of the capital-labor ratio,  $k$ , of this model is determined by the condition

$$(4) \quad [s - (1 - s)\lambda n]f(k) = nk.^4$$

In terms of Figure 1, the equilibrium value of  $k$  is determined by the intersection of the solid curve with the ray  $nk$  at  $k_0$ . Since  $s$  is less than

<sup>4</sup> This is equation (9) in Tobin [22]. Its derivation and interpretation will become clear from the discussion in Part II below; see especially footnote 14. Tobin also uses this equation to show that an increase in the rate of inflation increases the equilibrium value of  $k$ ; this, too, will be discussed below.

unity, this is necessarily less than the equilibrium ratio  $k_1$  that would be determined by the intersection of  $sf(k)$  with  $nk$  in the usual Solow barter model. [For the moment, the dotted curve  $\sigma f(k)$  should be ignored.] In Tobin's words, "equilibrium capital intensity is lower in the monetary model."<sup>5</sup>

On further reflection, however, this conclusion seems unreasonable. For if the sole result of introducing money into an economy were to reduce  $k$  and hence per capita output and consumption, why should it be introduced? Where are the vaunted advantages of a monetary economy?

This paradox leads us to the observation that though equation (3) does describe a positive demand for real money balances, the preceding model does not really provide a rationale for the holding of these balances. For such a rationale must interpret money balances either as a consumer's good or as a producer's good.<sup>6</sup> In the first case, the services rendered by money balances should appear in the individual's utility function and hence in his (imputed) disposable income; whereas in the second they should reflect themselves in the production function. Neither of these approaches, however, is reflected in the preceding model. For on the one hand, its production function is the same as that of a barter economy; while on the other, its definition of disposable income includes only the actual increase in the real value of cash balances, not the imputed value of their liquidity services. Thus the foregoing model is not really consistent with the existence of money.

## II. *Money as a Consumer's Good*

3. Let us now see how these difficulties are obviated by treating money as a consumer's good. Conceptually, this means that money enters the utility function and its imputed services are included in disposable income. In accordance with the principles of welfare economics, these services must clearly be valued at the alternative cost at the margin of holding money balances which, as shown in the preceding section, is the money rate of interest, or  $r + \pi$ . The relevant definition of disposable income is then

$$\begin{aligned} (5) \quad Y_D &= Y + \frac{M}{p} (\mu - \pi) + \frac{M}{p} (r + \pi) \\ &= Y + \frac{M}{p} (\mu + r), \end{aligned}$$

<sup>5</sup> [22, p. 71].

<sup>6</sup> Cf. Patinkin [14, pp. 146-47]. An attempt to clothe this somewhat formalistic statement with more economic meaning is provided [14, pp. 79-80, 117-19, 147-48, and 154]. Cf. also the beginning of Sec. 10 below.

where once again  $M/p$  represents the real quantity of money in the system.<sup>6a</sup> Thus real disposable income is defined as net national income ( $Y$ ) plus the real value of the increase in the nominal quantity of money ( $\mu M/p$ ) plus the imputed real interest on real money balances ( $r(M/p)$ ). Thus in contrast with (1), the decrease in the real value of money balances caused by a price increase ( $\pi(M/p)$ ) does not appear as a deduction from disposable income; for it is offset by the fact that  $\pi(M/p)$  also represents part of the imputed income from the holding of real balances.

It should be noted that a critical role in this offsetting is played by the assumption that the anticipated rate of price change (which is one of the components by which we value the liquidity services of the money balances) equals the actual rate (by which we measure the decrease in the real value of these balances). This also provides a key to an intuitive understanding of the offsetting. In brief, the quantity of real balances which the individual holds is, by assumption, the outcome of a decision made under the certain knowledge that prices will increase at the rate  $\pi$ ; hence the advantages of holding such balances must at least offset the loss generated by the price change. Alternatively, we can say that, in an economy in which everyone foresees with certainty a given price change and adjusts his money holdings accordingly, such a price change cannot—by definition—be said to generate the “capital losses” on these holdings which are assumed by the definition of disposable income presented in equation (1).<sup>7</sup>

Another point that should be made with reference to the foregoing

<sup>6a</sup> This definition has recently been criticized on the grounds that it leads to the allegedly paradoxical result that if the money rate of interest is zero, money balances will be at their satiety level—but real income “from this source” will then be zero [8a, p. 171, footnote 1]. This, however, is simply a specific instance of Adam Smith’s “water-diamond paradox”—arising, as is well known, from the difference between marginal and total utility. Correspondingly, if the foregoing “paradox” should lead us to measure the contribution of liquidity services to real national income by the area under the demand curve (as suggested [8a]), it should lead to a similar procedure with respect to water—or, for that matter, any other good.

At the same time it should be noted (as has been indicated in a discussion of this paper by Jürg Niehans at the Conference on Money and Economic Growth which took place at Brown University in June, 1968) that what we have called here “real income” is not the “real income” relevant for considerations of welfare economics in a world in which money enters the utility function; not because of the marginal evaluation of liquidity services, but because this definition measures “real income” only in terms of physical commodities, instead of in terms of an initial optimum basket consisting of both commodities and liquidity services. Correspondingly if by an appropriate quantity index we were to measure “real income” in terms of the number of such baskets that individuals can acquire, it would always be true that larger holdings of real balances would, *ceteris paribus*, imply a higher level of real income (but see below, Sec. 9).

These considerations do not invalidate the definition of real income adopted here; but they do preclude our interpreting the “income effect” of the resulting functions in terms of the Slutsky (or Hicks) income effect.

<sup>7</sup> All this is analogous to the familiar conclusion of demand theory that if an individual comes to market with a basket of goods which is an optimum one at the prevailing prices, then a change in these prices will generate a substitution effect, but not an income effect.

definition of disposable income (and the one of the preceding section as well) is that it treats the increase in real cash balances as part of income; in principle, however, it should be treated as an increase in wealth, which increases disposable income only by the permanent income stream which corresponds to it.<sup>8</sup> As has, however, already been noted, our major concern in this paper is with the steady-state growth path; and, as we shall see, the quantity of real cash balances along such a path increases at a constant rate per period; correspondingly, we can properly treat the increase during any given period as part of the income of that period. On the other hand, this definition is not, strictly speaking, valid for positions off the growth path and, in particular, for the stability analysis of this path. But we shall not deal with these complications here.

Let us now revise model (2)–(3) in the light of these considerations. Total consumption will now be represented by  $(1-s)[F(K, L) + (M/\dot{p})(\mu + r)]$ . But what should now be deducted from total commodity output in order to obtain investment in commodities is not *total* consumption, but *physical* consumption—which is the term we shall use (for want of a better one) to denote all consumption, except that of liquidity services. Thus condition (2) above is replaced by

$$(6) \quad \dot{K} = F(K, L) - \left\{ (1-s) \left[ F(K, L) + \frac{M}{\dot{p}}(\mu + r) \right] - \frac{M}{\dot{p}}(r + \pi) \right\},$$

where once again we have made use of the assumption that the price level instantaneously adjusts itself so as to equate the demand and supply for real balances; that is,

$$(7) \quad \frac{M^d}{\dot{p}} = \lambda F(K, L) = \frac{M}{\dot{p}}.$$

It should be noted that the *desired* level of physical consumption,  $C_P$ , should be represented not by the second term on the right-hand side of (6), but by

$$(8) \quad C_P = (1-s) \left[ F(K, L) + \frac{M}{\dot{p}}(\mu + r) \right] - \frac{M^d}{\dot{p}}(r + \pi).$$

That is, in measuring the disposable income which determines desired total consumption, the relevant quantities are the volume of transfer payments *actually* received by individuals (viz.,  $\mu M/\dot{p}$ ), and the imputed income from the real balances *actually* held (viz.,  $rM/\dot{p}$ ); for whether or not the latter balances are at their desired level, the individual can always consider them as convertible into physical capital

<sup>8</sup> Cf. [14, pp. 658–59].

yielding the (for him) given rate of return  $r$ . On the other hand, in determining the desired level of physical consumption, it is the amount of liquidity services which individuals *desire* to consume which is the relevant deduction from total *desired* consumption. Thus the form of (6) depends on assumption (7) that actual and desired quantities are equal.

We can also see from (8) that the real balance effect on  $C_P$ —that is, the effect on this consumption of an exogenous increase in the amount of real balances actually held by individuals—is determined by differentiating (8) partially with respect to  $M/p$ , keeping all other variables ( $K, L, \mu, \pi, r$ —and hence  $M^d$ ) constant. Thus the real balance effect implicit in (8) is  $\partial C_P / \partial (M/p) = \mu + r$ .

Two further observations might be made about model (6)–(7). First, in contrast with model (2)–(3), even in the extreme case of a stationary economy in which  $\mu = \pi = 0$ , real balances would continue to appear in the definition of income. Indeed, the real balance effect in (8)—properly modified—would then stem from the term  $(1-s)r(M/p)$ , which is also one of the ways in which the effect can be represented in short-run Keynesian models.<sup>9</sup> From this it is clear that the influence of  $(M/p)(\mu - \pi)$  on consumption in equation (2)—or of  $\mu(M/p)$  in equations (6) or (8)—cannot be identified with the real balance or Pigou effect in the usual sense of the term.

Second, it would be more consistent with general considerations of economic theory if the demands for both consumption commodities and money balances were represented as depending upon disposable income as defined by (5). This, however, would greatly complicate the comparative-dynamic analysis which follows, so that we continue to use the simpler equation (7). Note that this observation is equally relevant for the Tobin model.

4. Let us now consider the steady-state—or long-run-equilibrium—growth properties of model (6)–(7). Assume that the effective labor supply and the nominal quantity of money grow, respectively, at the constant rates  $n$  and  $\mu$ , where  $\mu$  (though not  $n$ ) can be negative. Define the steady-state growth path of the system as one in which both per capita physical capital and per capita real money balances (to be denoted by  $m$ ) are constant—and assume that such a path exists and that the system converges to it.

From the constancy of  $k = K/L$  along the steady-state path, it follows that

$$(9) \quad \frac{\dot{k}}{k} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L} = \frac{\dot{K}}{K} - n = 0.$$

<sup>9</sup> [14, pp. 658–59].

Similarly, the constancy of  $m = M/pL$  implies

$$(10) \quad \frac{\dot{m}}{m} = \frac{\dot{M}}{M} - \frac{\dot{p}}{p} - \frac{\dot{L}}{L} = \mu - \pi - n = 0.^{10}$$

Thus total physical capital and total real money balances both expand at the constant rate  $n$  along the path. It is also clear from (10) that  $\pi$  is constant along the path. Similarly, from the fact that  $r = f'(k)$  it is clear that the real rate of interest is constant.

Let us now determine the steady-state value of  $k$ . Substituting from (7) into (6), dividing through by  $K$ , and collecting terms we obtain

$$(11) \quad \frac{F(K, L)}{K} \{ \lambda n - s[1 + \lambda(n + \pi + r)] \} + n = 0,$$

where use has been made of (9) and (10). Dividing numerator and denominator of the first term by  $L$  and transposing then yields the steady-state condition that must be satisfied by  $\bar{k}$ ,

$$(12) \quad \{ s[1 + \lambda(n + \pi + r)] - \lambda n \} f(k) = nk.$$

The coefficient of  $f(k)$  in this equation can be given a straightforward economic interpretation. As Tobin has emphasized, the distinguishing feature of a money economy in a growth context is that not all of savings ( $S$ ) need be devoted to augmenting the stock of physical capital; instead some can be devoted to the accumulation of real money balances. That is, if savings devoted to the capital stock—or “physical savings”—are denoted by  $S_P$ , we have

$$(13) \quad S_P = S - \frac{d\left(\frac{M}{p}\right)}{dt},$$

which in our model can be rewritten as

$$(14) \quad S_P = s \left[ Y + \frac{M}{p} (\mu + r) \right] - \frac{M}{p} (\mu - \pi).^{11}$$

<sup>10</sup> Even though this equation equates the rate of increase of the price level with the rate of increase of the quantity of money (net of the rate of increase of output), it should not be interpreted as an expression of the quantity theory. For equation (10) does not depend on the behavior functions of the model, but is simply part of the definition of the steady state. Correspondingly, the long-run validity of the quantity theory in the model can be established only by showing that its behavior functions are such that it does indeed converge to a steady state.

<sup>11</sup> As the reader can verify, this result can also be obtained from the alternative definition

$$S_P = Y - C_P,$$

where  $C_P$  represents physical consumption; i.e., consumption exclusive of that of the services of money balances.

In the steady state, this becomes

$$(15) \quad S_P = sY[1 + \lambda(n + \pi + r)] - \lambda Yn,$$

where once again use has been made of (7), (9), and (10). Correspondingly, what we shall define as the "physical savings ratio" is

$$(16) \quad \sigma = \frac{S_P}{Y} = s[1 + \lambda(n + \pi + r)] - \lambda n,$$

which is seen to be the coefficient of  $f(k)$ .

It is clear from this definition that even in the case where the overall savings ratio  $s$  is constant,  $\sigma$  is not: for it depends on  $\lambda$ , which in turn depends on the money rate of interest  $i = r + \pi = f'(k) + \pi$ . Thus  $\sigma$  is a function of  $k$  and  $\pi$ ; and this functional dependence exists a fortiori in the more general case that will concern us, in which  $s$  too is assumed to be a variable, directly dependent on the respective rates of return which can be earned on the two assets in which form savings are held. That is, we shall assume that

$$(17) \quad s = s[f'(k), -\pi] \quad s_1 > 0 \quad s_2 > 0,$$

where  $s_1$  ( $s_2$ ) represents the partial derivative of function (17) with respect to the first (second) argument. As we shall see in the next section, it is this dropping of the assumption of a constant  $s$ —rather than the differing definitions of disposable income—which causes our model to yield results which are qualitatively different from those of the Tobin model.

Thus the condition for steady-state growth in the present model is seen to be completely analogous to the one in the original Solow model: for equation (12) states that a steady state will exist when (in per capita terms) the amount of new physical capital provided by savers (as represented by the left-hand side) equals the amount of new physical capital necessary in order to maintain a constant capital-labor ratio (as represented by the right-hand side). From this interpretation it follows that if a steady state exists, then  $\sigma$  must be greater than zero: for since the labor supply is growing, there must be positive physical savings in order to maintain a constant capital-labor ratio.

It is also clear from (16) that  $\sigma$  is not necessarily less than  $s$ . Correspondingly, the dotted curve  $\sigma f(k)$  in Figure 1 can intersect the ray  $n\bar{k}$  rightwards of  $k_1$ . Thus unlike the situation in the Tobin model, the capital-labor ratio in the steady state of the monetary economy is not necessarily less than the barter one. And even when it is, this does not mean that the individuals in the economy are worse off; for they now

derive utility from money balances as well as from physical consumption.

5. Consider now the comparative-dynamic properties of the system. For this purpose let us first rewrite the steady-state condition (12) as

$$(18) \quad \frac{f(k)}{r} = a(k) = \frac{n}{r(k, \pi)},$$

where  $a(k)$  represents average output per unit of capital. As will be shown below (footnote 16), under certain assumptions as to the form of the production function, this equation has a unique strictly positive solution for  $k$ , as of any given value of  $\pi$ . The basic question which now concerns us is the effect on this solution of a change in the rate of monetary expansion  $\mu$ . From (10) we see that in the steady state,  $\mu$  and  $\pi$  differ only by the constant  $n$ . Hence the answer to our question can be determined by implicitly differentiating  $k$  with respect to  $\pi$  in equation (18).

Carrying out this differentiation, we obtain

$$(19) \quad a'(k) \frac{dk}{d\pi} = -\frac{n}{\sigma^2} \left( \sigma_k \frac{dk}{d\pi} + \sigma_\pi \right),$$

and therefore

$$(20) \quad \frac{dk}{d\pi} = \frac{\sigma_\pi}{-\frac{\sigma^2}{a'(k)} - \sigma_k}$$

where  $\sigma_k$  and  $\sigma_\pi$  are the partial derivatives of  $\sigma$  with respect to  $k$  and  $\pi$ , respectively.

Under the assumption of a linearly homogeneous production function with positive marginal products for each factor, the average product  $a(k)$  must be declining; that is,  $a'(k) < 0$ . The signs of  $\sigma_\pi$  and  $\sigma_k$ , however, cannot be specified a priori. For differentiating (16) partially, we obtain

$$(21a) \quad \sigma_k = f''(k) \{ s_1 [1 + \lambda(n + \pi + r)] + s [\lambda'(n + \pi + r) + \lambda] - \lambda' n \}$$

$$(21b) \quad = s_1 f''(k) [1 + \lambda(n + \pi + r)] + \lambda s \left[ 1 + \frac{\lambda'}{\lambda} (\pi + r) \right] f''(k)$$

$$- (1 - s) \lambda' f''(k) n$$

and

$$(22) \quad \sigma_\pi = -s_2 [1 + \lambda(n + \pi + r)] + \lambda s \left[ 1 + \frac{\lambda'}{\lambda} (\pi + r) \right] - (1 - s) \lambda' n.$$



Consider now the signs of these expressions. By assumption,  $0 < s < 1$ ,  $s_1 > 0$ ,  $s_2 > 0$ ,  $f''(k) < 0$ ,  $\lambda' < 0$ , and  $r + \pi$  (the money rate of interest)  $> 0$ . Hence each of the terms in (21b) is negative with the possible exception of the second one. Consider now the expression  $(\lambda'/\lambda)(\pi + r)$ . This is the partial elasticity of the demand function for real balances (7) with respect to the money rate of interest. In accordance with the findings of most empirical studies,<sup>12</sup> this can be assumed to be less than unity in absolute value. Hence  $\sigma_k$  can be assumed to be negative. On the other hand, even under the assumption of an inelastic demand, the sign of  $\sigma_r$  is indeterminate.

These results can be given a straightforward economic interpretation. An increase in  $k$  or  $\pi$  affects the physical-savings ratio in two ways: first, by changing the total savings corresponding to a given level of physical output (and this will be called the "overall-savings effect"); second, by changing the proportion of the two forms—physical capital and real money balances—in which these savings are held (and this will be called the "composition effect"). The overall-savings effect, in turn, is directly dependent on the changes in two factors: the overall-savings ratio and the level of imputed income from money balances. These two components of the overall-savings effect are respectively represented by the first two terms in (21b) and (22), whereas the composition effect is represented by the last term. (Note that the overall-savings and composition effects do not correspond to the wealth and substitution effects, respectively. For one component of the overall-savings effect is the change in  $s$  caused by a change in the rate of return, which thus reflects a substitution between present and future consumption.)

Thus the three terms of equation (21b) can be interpreted as follows: An increase in  $k$  reduces the real rate of interest  $r = f'(k)$  and hence reduces the overall-savings ratio [i.e.,  $s_1 f''(k) < 0$ ]. Similarly, it reduces the money rate of interest and hence increases the holdings of real money balances, but (by the assumption of inelastic demand) less than proportionately, so that the imputed disposable income from these balances decreases [i.e.,  $(1 + \eta)f''(k) < 0$ , where  $\eta$  is the elasticity of demand for money balances]. Hence the overall-savings effect is unequivocally negative. At the same time, the composition effect is also negative: for no matter what the elasticity of demand, the fact remains that the reduction in the money rate of interest has diverted a larger proportion of savings to the accumulation of real money balances [i.e.,  $-(1 - s)\lambda' f''(k) < 0$ ]. Hence an increase in  $k$  necessarily decreases  $\sigma$ .

In contrast, the three terms of equation (22) imply that the effect of an increase in  $\pi$  cannot be specified a priori. For though the resulting

<sup>12</sup> Cf., e.g., the summary of such studies in Teigen [19, p. 505]. See also de Leeuw [2, p. 493]; Goldfeld [5, pp. 77–78]; and Laidler [9].

increase in the money rate of interest generates a positive composition effect, the overall-savings effect is indeterminate. For on the one hand (assuming inelastic demand) the increased money rate of interest increases the imputed disposable income from money balances; but on the other, the increase in  $\pi$  means a decrease in the rate of return from money balances  $-\pi$  and hence in the overall-savings ratio  $s$ .

Let us now summarize the implications of this discussion for equation (20). Most reasonably, this equation states that a change in  $\pi$  will affect the steady-state value of  $k$  if and only if it affects the physical savings ratio  $\sigma$ . Furthermore, if the demand for money balances is inelastic, then  $k$  will change in the same direction as  $\sigma$ : for then the denominator of (20) is positive, so that  $\text{sign } dk/d\pi = \text{sign } \sigma_\pi$ . In the special case in which the overall-savings and composition effects of an increase in  $\pi$  exactly offset each other,  $\sigma_\pi = 0$ , so that  $k$  is not affected by a change in the rate of monetary expansion. If the composition effect should predominate, then  $\sigma_\pi$  is positive and hence so is  $dk/d\pi$ . The more insensitive the overall-savings ratio to changes in  $-\pi$  (i.e. the smaller  $s_2$ ), the more likely is this predominance to occur. Indeed, in the extreme case in which  $s_2 = 0$  (and a fortiori in the case where  $s$  is constant with respect to both  $r$  and  $\pi$ ), the overall-savings effect of an increase in  $\pi$  will reinforce the composition effect in causing  $k$  to increase.<sup>13,14</sup>

By making use of the correspondence principle, we can derive these results without making any direct assumptions about the elasticity of demand for money. For as will be shown in Section 7 below [see especially equation (33)], stability of the system implies that the denominator of (20) is positive. Hence if the system is stable,  $\text{sign } dk/d\pi = \text{sign } \sigma_\pi$ .

In terms of Figure 1—and this will also be shown below—stability of the system implies that the curve  $\sigma f(k)$  cuts the ray  $nk$  from above.

<sup>13</sup> Note that the overall-savings effect will cause  $k$  to increase even if we assume that  $\lambda$  is constant, so that there is no composition effect. It is, however, somewhat inconsistent to assume that real balances are valued at the money rate of interest, while at the same time assuming that the demand for these balances is unaffected by this rate.

<sup>14</sup> The reader can readily verify that in the Tobin model of Sec. 2 above, equations (23), (21b), and (22) reduce respectively to

$$\sigma = s - (1 - s)\lambda\pi$$

which is, of course, the coefficient of  $f(k)$  in equation (4),

$$\sigma_k = f''(k)[s_1(1 + \lambda\pi) - (1 - s)\lambda'n],$$

and

$$\sigma_\pi = -s_2(1 + \lambda\pi) - (1 - s)\lambda'n.$$

Here the sign of  $\sigma_k$  is unequivocally negative; but the sign of  $\sigma_\pi$ —and hence, by equation (20), of  $dk/d\pi$ —remains indeterminate. Thus the indeterminacy remains even with the Tobin definition of disposable income.

Actually, however, Tobin restricts his analysis to the case in which  $s$  is constant, and so concludes that  $dk/d\pi$  is unequivocally positive; Tobin [22, pp. 70 and 71-72]. This conclusion is also reached by Stein [18, pp. 461-63], though under somewhat different assumptions.

Hence if an increase in the rate of monetary expansion (and hence  $\pi$ ) should cause  $\sigma f(k)$  to shift upwards at the initial equilibrium position.  $A$  in Figure 1 [and this is the graphical meaning of  $\sigma_\pi > 0$  in equation (20)], then the new point of intersection will be rightwards of  $A$ , which means that the long-run-equilibrium value of  $k$  will increase. Conversely, this value will decrease if the increase in  $\pi$  causes a downward shift in  $\sigma f(k)$  in the neighborhood of point  $A$ .

It should now be emphasized that the foregoing analysis has been based on a savings function whose form has been postulated, and not derived from considerations of utility maximization. If, however, the latter (and surely preferable) approach is followed, and if the individual is assumed to maximize his utility over an infinite horizon at a constant rate of subjective time preference  $\delta$ , then it can be shown<sup>15</sup> that the steady-state value of  $k$  is unaffected by a change in  $\mu$  and hence  $\pi$ . This is the immediate consequence of the fact that under these assumptions the system cannot be in equilibrium unless the marginal productivity of capital equals the rate of time preference plus the rate of population growth; that is unless  $f'(k) = \delta + n$ . And for a given  $\delta$  and  $n$ , this uniquely fixes  $k$ . This invariance of  $k$  would remain true even if  $\delta$  were not constant, but depended on  $k$ . But it would not remain true if  $\delta$  depended in some way on  $m$ —as would, for example, be the case if it depended on the ratio of wealth to disposable income. Nor, as we shall see at the end of Sec. 11 below, would it be true if money entered the production function.

We have so far concentrated our attention on the effect of an increase in the rate of monetary expansion on the steady-state capital-labor ratio. Let us now consider its effect on the corresponding money-labor ratio, or  $m = M/pL$ . For this purpose let us divide (7) through by  $L$  and rewrite it as

$$(23) \quad m = \lambda[f'(k) + \pi] \cdot f(k).$$

In the case in which  $dk/d\pi < 0$ , the effect of an increase in  $\pi$  is unequivocally negative: for it generates a decrease in both  $\lambda$  and  $f(k)$ , where the decrease in the former is caused by an increase in both components of the money rate of interest,  $f'(k) + \pi$ . If, however,  $dk/d\pi > 0$ , then the effect is indeterminate: for on the one hand  $f(k)$  increases; whereas, on the other, because of the decline in  $f'(k)$ , there may be a

<sup>15</sup> See the excellent article by Sidrauski [15]. The utility function must satisfy some additional restrictions.

In connection with the following argument, note that the assumption of a constant  $\delta$  is a very strong one, implying the existence of other invariances in the system as well. In particular, it implies that no matter what the form of the production function (assuming constant technology), the steady-state real rate of interest (though generally not the level of  $k$ ) remains constant and equal to  $\delta + n$ . Similarly, it implies that a shift in liquidity preference which does not affect the rate of time discount will not affect the steady-state value of  $k$ , and hence will also leave the rate of interest invariant.

net decrease in the money rate of interest, thus causing  $\lambda$  to increase. The nature of this indeterminacy can be seen more rigorously by differentiating (23) with respect to  $\pi$  to obtain

$$(24) \quad \frac{dm}{d\pi} = \lambda' \cdot [f''(k) \frac{dk}{d\pi} + 1] f(k) + \lambda f'(k) \frac{dk}{d\pi}.$$

The foregoing technique can also be used to analyze the effect of a shift in liquidity preference. For this purpose we assume that  $\lambda$  also depends directly on a taste parameter  $\alpha$ . That is,  $\lambda = \lambda[f'(k) + \pi, \alpha]$  where  $\lambda_1$  (corresponding to  $\lambda'$  above) is again negative and  $\lambda_2$  positive. From (16) it is then clear that the physical-savings ratio  $\sigma$  also depends on  $\alpha$ , and that its partial derivative with respect to this variable is  $\sigma_\alpha = [s(\pi + r) - (1-s)n]\lambda_2$ , whose sign is indeterminate. This indeterminacy reflects the fact that an increase in  $\alpha$  will, *ceteris paribus*, increase money balances, hence the imputed income from these balances, and hence total savings; but at the same time it will increase the amount of these savings diverted to the accumulation of real balances.

It is clear from (10) that an increase in liquidity preference will not affect the steady-state value of  $\pi$ —for, by definition, it does not affect  $\mu$ . Hence the effect of such an increase on the steady-state value of  $k$  can be obtained by replacing the denominator of equation (18) by  $\sigma(k, \pi, \alpha)$ , and implicitly differentiating this equation with respect to  $\alpha$ , while keeping  $\pi$  constant. This yields an expression identical with equation (20), except for the replacement of  $dk/d\pi$  and  $\sigma_\pi$  by  $dk/d\alpha$  and  $\sigma_\alpha$ , respectively. Thus the sign of  $dk/d\alpha$  is indeterminate.

By using an argument analogous to that of equation (24), one can then show that  $dm/d\alpha$  is indeterminate if  $dk/d\alpha < 0$ , and positive if  $dk/d\alpha \geq 0$ . Thus a priori one cannot even say whether an increase in liquidity preference will increase long-run-equilibrium real balances. Note that this indeterminacy holds in the Tobin model as well. For disregarding the imputed income from liquidity services only enables us unequivocally to infer that  $\sigma_\alpha$ , and hence  $dk/d\alpha$  are negative; but this decrease in  $k$  causes interest to rise and output to fall—thus tending to decrease the amount of money demanded. Hence, if this tendency is sufficiently strong, it can offset the initial rightward shift in the demand function for money caused by the increase in liquidity preference.

6. Even though the effect of a change in  $\pi$  on the steady-state value of  $k$  is indeterminate in the small, it can be shown that under the assumptions of the preceding section a sufficiently large decrease in  $\pi$  must decrease  $k$ .

The argument will be carried out with the aid of Figure 2. The curve  $EE$  represents the relation between the steady-state value of  $k$  and the rate of price change  $\pi$  as given by (18). The slope of this curve is repre-



on money,  $-\pi$ , must be less than the yield on physical capital,  $r$ ; for otherwise liquidity considerations would cause everyone to shift out of the latter and into the former. This means that the steady-state level of  $k$  corresponding to any given value of  $-\pi$  must have a marginal productivity greater than this value; in graphical terms,  $EE$  must be to the right of  $QQ$ . If we now make the further assumption that for every level of  $\pi$  there does indeed exist a steady-state value of  $k$ , then it follows that, as  $\pi$  approaches  $-\infty$ , the curve  $EE$  must also approach the horizontal axis asymptotically. Thus a sufficiently large price decline must necessarily cause a decrease in  $k$ .

This conclusion has implications for the possibility, discussed by Tobin, that the steady-state value of  $k$  might correspond to a marginal productivity and hence real rate of interest which lies below some minimum level (say,  $r_0$ ) insisted upon by potential investors, while potential savers are quite willing to continue saving at this rate. In such a Keynesian situation (represented by point  $B$  in Figure 2) full employment could not prevail. But the preceding argument implies that the monetary authorities could always solve this unemployment problem by carrying out a sufficiently deflationary policy. Thus, for example, if they were to cause prices to decline at the rate  $\pi_2$ , the resulting decrease in  $k$  would raise the real rate to  $r_2$ , safely above the critical minimum.<sup>17</sup>

In brief—and in somewhat oversimplified terms—by carrying out a deflationary policy, the monetary authorities siphon off savings into the accumulation of real money balances; hence by choosing a deflation of the appropriate severity, they can leave an amount of savings for physical-capital accumulation which is consistent with the minimum rate of return (and hence maximum capital intensity) insisted upon by investors. If unemployment is caused by people “wanting the moon,” then the monetary authorities can indeed provide them with the moon.

7. We have until now assumed that the system converges to a steady state, i.e., that it is stable. Let us now examine this assumption. The general analysis of the problem yields complicated expressions which can be evaluated only by placing additional restrictions upon the system.<sup>18</sup> For simplicity, then, we shall limit our stability analysis to the case in which the monetary authorities decide upon a constant rate of price change,  $\pi_0$ , that they wish always to maintain (i.e., out of the steady-state as well), and carry out this policy by making continuous adjustments in the rate of change of the money supply.<sup>19</sup> From the

<sup>17</sup> Tobin [21, pp. 675, 680–681].

<sup>18</sup> See the references in footnote 20 below.

The reader who is not interested in the technical analysis of stability conditions can omit this section without loss of continuity.

<sup>19</sup> This is the useful device employed by Johnson [7, p. 281].

logarithmic differentiation of the money excess-demand equation (7) we have

$$(25) \quad \frac{\dot{\lambda}}{\lambda} + \frac{\dot{Y}}{Y} = \mu - \pi;$$

hence the foregoing policy requires that the rate of change of the money supply at any instant of time be

$$(26) \quad \mu = \pi_0 + \frac{\dot{\lambda}}{\lambda} + \frac{\dot{Y}}{Y} = \pi_0 + \frac{\lambda' f''(k) \dot{k}}{\lambda} + \frac{f'(k) \dot{k}}{f(k)} + n.$$

In the steady state  $\dot{k}=0$ , so that the necessary rate is constant at  $\mu=\pi_0+n$ , as in (10).

In order to analyze the stability of the system under this assumption we substitute from (7) into (6) (again reflecting the assumption that the equilibrium condition in the money market is always satisfied), divide through by  $K$ , and rearrange terms to yield the differential equation

$$(27) \quad \frac{\dot{K}}{K} = \frac{\dot{k}}{k} + n = \frac{f(k)}{k} \{s[1 + \lambda(\mu + r)] - \lambda(\mu - \pi)\}$$

or

$$(28) \quad \frac{\dot{k}}{k} = a(k) \{s[1 + \lambda(\mu + r)] - \lambda(\mu - \pi)\} - n,$$

where  $\mu$  is no longer constant, but instead varies in accordance with (26). Substituting, then, from this equation and rearranging terms yields

$$(29) \quad \frac{\dot{k}}{k} = \frac{\sigma(k; \pi_0) a(k) - n}{G(k; \pi_0)} = \frac{\sigma(k; \pi_0) f(k) - n k}{k G(k; \pi_0)},$$

where

$$(30) \quad G(k; \pi_0) \equiv 1 + (1 - s) a(k) k \lambda' f''(k) + (1 - s) \lambda f'(k) > 1,$$

where  $s$  and  $\lambda$  are functions of  $k$  and  $\pi_0$ , as above. Note that setting  $\dot{k}=0$  in equation (29) reduces it (as it must) to steady-state condition (18).

Stability of the system in the small means that any chance increase (decrease) in  $k$  above (below) its steady-state level generates automatic market forces to return it to this level. Thus a necessary and sufficient condition for this stability is that  $d(\dot{k}/k)/dk < 0$  in the neighborhood of the steady-state position. Carrying out this differentiation in (29) yields

$$(31) \quad \frac{d\left(\frac{k}{k}\right)}{dk} = \frac{G'(\cdot) \frac{d[\sigma(k; \pi_0)a(k) - n]}{dk} - [\sigma(k; \pi_0)a(k) - n] \frac{dG(\cdot)}{dk}}{[G(\cdot)]^2},$$

which is to be evaluated at steady-state values. Since  $\sigma a(k) - n$  is then zero, it follows that

$$(32) \quad \begin{aligned} \text{sign} \frac{d\left(\frac{k}{k}\right)}{dk} &= \text{sign} \frac{d[\sigma(k; \pi_0)a(k) - n]}{dk} \\ &= \text{sign} [\sigma_k a(k) + \sigma a'(k)] \\ &= \text{sign} \left[ \sigma_k \frac{n}{\sigma} + \sigma a'(k) \right] \\ &= \text{sign} \left[ \sigma_k + \frac{\sigma^2}{n} a'(k) \right] \end{aligned}$$

in the neighborhood of the steady state. Hence the system is stable under our present assumptions if, and only if,  $\sigma_k + (\sigma^2/n)a'(k)$  is negative. Thus, as already indicated in our discussion of equation (20), the assumption that the system is stable provides information about the comparative-dynamics properties of the system.

The economic interpretation of the foregoing stability condition is straightforward. A chance increase in  $k$  above its steady-state value will affect the level of capital intensity both by affecting the physical-saving ratio and by affecting the output (per unit of capital) out of which such savings are made. Hence if these influences are on balance negative, the degree of capital intensity  $k$  will be forced back to its original level. If, however, the increase in  $k$  causes  $\sigma$  to increase (as will be the case if the demand for money is sufficiently elastic), and if this effect is strong enough to overcome the negative effect on average output, then the degree of capital intensity will be further increased, thus rendering the system unstable. On the other hand, it is clear that under the assumption of an inelastic demand as made in Section 5, the system is stable.

It should, however, be emphasized that this stability depends in a crucial way on the assumption that  $\pi$  remains constant throughout the adjustment process. For assume that  $\pi$  increases. This causes a shift out of money and into commodities, tending to increase  $\pi$  even further. There is, of course, the countervailing force that the increase in the price level decreases the real value of cash balances, and thus tends to restore portfolio equilibrium. But in the absence of special assump-



tions, there can be no assurance as to which of these two forces will prevail.<sup>20</sup>

We now note that the foregoing mathematical development implies that the basic dynamics of the system can actually be analyzed in the usual manner in terms of the curves  $\sigma(k; \pi_0)f(k)$  and  $nk$  in Figure 1—even though these curves do *not* take account of the compensatory monetary policy described by (26). In particular, equation (29) implies that the sign of  $\dot{k}$  is always the same as that of the difference between these two curves; the compensatory changes in  $\mu$  do influence  $\dot{k}$ , but only to make it smaller in absolute value than this difference.

Again, the stability condition described by (32) will be satisfied if, and only if,  $\sigma(k; \pi_0)f(k)$  cuts  $nk$  from above. For form the function  $z = \sigma(k; \pi_0)f(k) - nk$ , divide it through by  $k$ , and differentiate  $w = z/k = \sigma(k; \pi_0)a(k) - n$  with respect to  $k$ . Evaluating the resulting derivative at equilibrium point  $A$  in Figure 1—at which  $z = 0$ —we then have

$$(33) \quad \begin{aligned} \text{sign } \frac{dw}{dk} &= \text{sign } \frac{k \frac{dz}{dk} - z}{k^2} = \text{sign } \frac{dz}{dk} \\ &= \text{sign } [\sigma_k a(k) + \sigma a'(k)]. \end{aligned}$$

Hence,  $z$  will be positive immediately to the left of  $A$ , and negative immediately to the right—if and only if  $dz/dk$  is negative when evaluated at point  $A$ ; that is, if and only if a negative sign obtains in (32).

An immediate implication of this argument is that under the assumptions of Section 5, the system is stable in the large as well as in the small. For, by the argument of footnote 6,  $\sigma(k; \pi_0)f(k)$  then lies above (below) the ray  $nk$  at any point to the left (right) of point  $A$  in Figure 1. Hence there always exist forces pushing  $k$  toward the steady-state value, which must exist.

8. Let us now consider the implications of the foregoing discussion for the question of the neutrality of money in the context of the steady state. By such neutrality we mean that monetary changes do not affect the steady-state value of  $k$  and hence real rate of interest. As we shall, however, see below, there are some problems with reference to this definition.

As has already been emphasized in the literature,<sup>21</sup> there are two dif-

<sup>20</sup> Cf. Tobin [21, pp. 682–84]. For a detailed discussion of stability conditions in a model with a variable  $\pi$ , see Sidrauski [15] [16]. For a corresponding discussion with respect to a somewhat different model, see Stein [18, pp. 458–61]. In the Sidrauski analysis a vital role is played by another factor from which we have here abstracted—namely, the way in which price expectations are formed.

<sup>21</sup> See Marty [11, p. 56] and Tobin [22, p. 69].

ferent aspects of this question: the influence of the *absolute* quantity of money (and hence the absolute price level) on the steady-state path, and the influence of the *rate of change* of money (and hence the rate of change of this price level) on the path. From steady-state condition (12) we see that the long-run equilibrium value of  $k$  depends only on the latter. From this it follows that if at any point on the steady-state path the quantity of money should (say) double, and if subsequently the monetary authorities should continue with the same rate of monetary expansion as before—then the long-run equilibrium value of  $k$  will not be affected. Hence, by (23), neither will the corresponding equilibrium value of  $m$ . All that will occur is that immediately after the doubling of the quantity of money there will, by (6), be a positive real-balance effect which will increase the demand for commodities and thus cause the price level to rise faster than usual with consequent effects on  $k$ ; but if the system is stable, this more rapid rise in prices will continue only until it has reduced the real value of cash balances (and hence demand for commodities) to what they otherwise would have been—at which point the system will have returned to a long-run equilibrium with the same value of  $\pi$ , and hence  $k$  and  $m$ , as before, but with an absolute price level twice its previous height.

Thus in this sense—which corresponds to that of the traditional quantity theory, with its emphasis on the fact that there can be no real consequences of a change in the monetary unit—money is neutral. On the other hand, as equation (20) shows, money will not generally be neutral in the second sense. Basically, this is a reflection of the fact that different rates of expansion of the money supply imply different rates of return on the holding of real balances, and hence different decisions as to the optimum combinations of the assets (real balances and physical capital) which the individual chooses to hold. Hence the equilibrium amounts of these assets in the economy will in general also be different.

Only if the scale and composition effects of equation (20) exactly offset each other will money be neutral in the second sense too. In this special case the increase in  $\mu$  leaves  $k$  and hence the real rate of interest unaffected, and merely causes the money rate of interest to increase by the same amount that  $\pi$  does. This is the conclusion associated with the traditional discussions of the neutrality question.<sup>22</sup>

But what must now be emphasized is that even in this “neutral” case the increase in  $\mu$  and hence  $\pi$  will affect the steady-state level of some

<sup>22</sup> Cf., e.g., Lerner [10 pp. 329–30]. Fisher himself did not believe that the money rate increased by the full extent of the rate of price increase—but only because he attributed imperfect foresight to individuals (Fisher [4, pp. 43–44]).

The fact, shown above, that the real rate of interest will generally be affected by a monetary expansion has been instructively demonstrated within the framework of the more familiar IS-LM diagram by Mundell [12] [13].

of the real variables of the system. For it is clear from (24) that it is impossible for both  $k$  and  $m$  to remain invariant under a change in  $\pi$ . Thus in the case just discussed the increase in the money rate of interest will decrease the demand for money and hence  $m$ .<sup>23</sup> Correspondingly, by (5), it will change real disposable income. Conversely, if we define "neutrality" as a change which does not affect per capita real disposable income, then it is clear from (5) that it must affect either  $k$  and/or  $m$ . More specifically, substituting  $\mu = \pi + n$  into (5), converting it to the intensive form  $y_D = y + m(\pi + n + r)$ , and differentiating with respect to  $\pi$  yields

$$(34) \quad \frac{dy_D}{d\pi} = f'(k) \frac{dk}{d\pi} + m \left[ 1 + f''(k) \frac{dk}{d\pi} \right] + [\pi + n + f'(k)] \frac{dm}{d\pi}.$$

Hence, taking account of (24), it is possible to have a case in which  $dy_D/d\pi = dm/d\pi = 0$  and  $dk/d\pi > 0$ ; it is also possible to have a case in which  $dy_D/d\pi = dk/d\pi = 0$  and  $dm/d\pi < 0$ ; but it is not possible to have a case in which  $dy_D/d\pi = dk/d\pi = dm/d\pi = 0$ .

In sum, once we include money services in the definition of income, it is impossible for a variation in the rate of change of the money supply to be neutral in the sense of leaving invariant all the real variables of the system.

We conclude with some brief comments on shifts in liquidity preference. As we saw at the end of Sec. 5, such a shift will generally affect the steady-state level of  $k$ . This, however, should not really be interpreted as a deviation from the neutrality of money. For in system (6)–(7)—as in most growth models—physical savings and investment are assumed to be identical. More specifically, individuals are assumed to make decisions only as to savings, which are then transferred directly and without any friction into investment. Now, it is clear from (6)–(7) that a shift in  $\lambda$  represents not only a shift in the demand for money, but also (through the influence of  $M/p$  in equation (6)) a shift in physical consumption and hence savings. Hence it is perfectly in keeping with the classical and neoclassical tradition to conclude that such a shift will generally affect the real rate of interest.

Conversely, a neutral shift in liquidity preference could take place in a growth model which permitted individuals to make independent savings and investment decisions, and which assumed that the shift in liquidity preference simultaneously and directly affected these decisions in offsetting ways. This, of course, is what would take place in such a

<sup>23</sup> More specifically, substituting  $dk/d\pi = 0$  in equation (24) yields

$$\frac{dm}{d\pi} = \lambda' f(k) < 0.$$

model if the shift in liquidity preference were to be accompanied by simultaneous and equi-proportionate shifts in the demands for consumption and investment commodities, respectively.

9. We consider finally the implications of the foregoing analysis for one aspect of the problem of optimum growth: namely, the choice of a path with the highest *constant* level of utility per unit of time. As has been emphasized in the literature, such a steady-state path is not necessarily an optimum one in the sense of maximizing total utility over the entire economic horizon: for if there exists positive subjective time preference, total utility could be increased by consuming some of the capital in this initial steady-state path, and then settling down to another such path at a lower level of consumption. Nevertheless, since the problem has been much discussed in the literature, it is worthwhile commenting briefly upon it.

Just as in the preceding discussion of the nature of neutrality, the major point here is that this utility now depends not only on physical consumption, but also on real money balances. By definition, per capita physical consumption is

$$(35) \quad c(k) = f(k) - \sigma f(k),$$

which in the steady state reduces to

$$(36) \quad c(k) = f(k) - nk.$$

Hence the relevant representative utility function is

$$(37) \quad U = U(c, m) = U[f(k) - nk, m],$$

and the necessary condition for utility maximization is that

$$(38) \quad dU = U_1 \cdot [f'(k) - n]dk + U_2 dm = 0$$

for all possible differential movements  $dk$  and  $dm$ . Assuming non-satiety of commodity consumption (i.e.,  $U_1 \neq 0$ ), this condition will be satisfied if and only if the equations

$$(39) \quad f'(k) - n = 0$$

$$(40) \quad U_2[f(k) - nk, m] = 0$$

are simultaneously satisfied.

In the usual discussion of optimum policy, it is assumed that the policy authorities are free to fix certain parameter(s) so as to satisfy the appropriate utility-maximizing conditions. So far we have assumed that the only policy parameter is  $\mu$ , or, equivalently,  $\pi$ . Let us, however, now assume that the authorities control yet another parameter,  $\beta$  (representing, say, fiscal policy), which also affects the overall-savings ratio  $s$ . This means that this ratio is now represented not by (17), but by  $s$

$= H[f'(k), -\pi, \beta]$ . In principle, then, equations (18) and (23)—with  $\sigma$  now assumed to depend also on  $\beta$ —could be solved out for  $k$  and  $m$  as a function of the policy parameters  $\beta$  and  $\pi$ ; and these solutions could then be substituted into equations (39)–(40). This would give us two equations to be solved out for the two parameters  $\pi$  and  $\beta$ , whose solutions would, of course, be the optimum values of these parameters.

Thus these assumptions lead to the usual Golden Rule (39); namely, that the optimum policy is that which generates a level of  $k$  whose marginal product equals the rate of growth of the economy. The assumptions also lead to the conclusion that the optimum real quantity of money is that which renders its marginal utility equal to zero—which, under the present assumptions, is also the marginal cost to society of producing real outside-money balances. This satiety level of balances can be assumed to be achieved when the alternative cost of holding money, as measured by the money rate of interest,  $i$ , is also zero. Since  $i = f'(k) + \pi$ , it follows that the optimum rate of price change under these conditions is  $-\pi = f'(k) = n$ . That is, the optimum rate of price decrease equals the rate of growth of output. Correspondingly, optimum monetary policy calls for a constant quantity of money: i.e.,  $\mu = \pi + n = 0$  (cf [11, p. 57] and [7, p. 284].)

Within the context of our model, however, a more interesting question is the nature of optimum policy when—as in the analysis of the preceding sections—the authorities are free to determine only the parameter  $\pi$ . Formally, this means that (39)–(40) could be reduced to two independent equations in the single parameter  $\pi$ ; correspondingly, it would not generally be possible to fix a value for this parameter which could simultaneously satisfy both equations.

The economic implications of this argument can be made clearer by first rewriting maximum condition (38) as

$$(41) \quad \frac{dU}{d\pi} = U_1 \cdot [f'(k) - n] \frac{dk}{d\pi} + U_2 \frac{dm}{d\pi} = 0.$$

From (24) it is clear that  $dm/d\pi$  generally differs from zero; hence it is equally clear that the rate of price change  $\pi$  that the monetary authorities must impose in order to satisfy (41) is not generally the one that will generate the steady-state capital-labor ratio  $k$  specified by Golden Rule (39). Conversely, and more to the point, the authorities would not generally be acting in an optimum manner if they made use of their policy parameter  $\pi$  to bring the economy to a position in which this Rule would be satisfied. In brief, since by assumption the individual also derives utility from the holdings of cash balances, the proper choice of  $\pi$  must take account of its influence on these holdings as well as on the level of physical consumption.

In a similar way condition (41) implies that, if  $dk/d\pi \neq 0$ , then the optimum is reached at a point where  $U_2 \neq 0$ ; that is, at a point where real balances are not at their satiety level. This reflects the fact that in the present context—in which the individual is constrained to remain at a constant level of utility—there is, in fact, a social cost attached to increasing  $m$  by decreasing  $\pi$ ; for the latter decrease may also decrease  $k$ , hence  $f(k)$ , and hence per capita physical consumption. This argument, however, cannot be carried over to the case in which the individual is free to maximize his utility over the entire time horizon without being subject to the foregoing restraint.<sup>24</sup>

### III. *Money as a Producer's Good*

10. Let us now briefly consider the alternative of treating money as a producer's good. By this we mean that money is held only because it enables the economic unit in question to acquire or produce a larger quantity of commodities, in the usual sense of the term. On the other hand, money holdings per se are assumed not to generate any utility.<sup>25</sup>

One way of carrying out this approach is to analyze the demand for money by means of the usual techniques of optimum-inventory theory.<sup>26</sup> However, though we are now indeed considering money as an inventory, we shall adopt the analytically simpler (though less precise) technique of directly introducing the real quantity of money into the production function. In particular, we shall assume that all money balances are held by the business sector of the economy, whose production function has the form  $Y = G(K, L, M/p)$ , which is again assumed to be linearly homogeneous in all the variables. This function can be interpreted as reflecting the assumption that just as production depends on fixed capital, so it depends on working capital. Thus real money balances can be considered just like any other inventory which enters into the productive process. Note that within the context of steady-state growth (in which the increase in total output is the result of an increase in the number of firms in the economy, each producing the same amount) the assumption of linear homogeneity can hold even if there should be intrafirm economies of scale in connection with money balances [cf. 14, pp. 87–88].

In somewhat more concrete—and more familiar—terms we can assume that an economy without money would have to devote effort (read: labor and physical capital) in order to achieve the multitude of

<sup>24</sup> We are indebted to Miguel Sidrauski for very helpful comments on this section. We are also indebted to Milton Friedman and Hirofumi Uzawa for pointing out an erroneous interpretation of the optimum which appeared in an earlier draft.

<sup>25</sup> For further clarification of this distinction see [14, pp. 146–47].

<sup>26</sup> Cf. Baumol [1], Tobin [20], and Patinkin [14, Ch. VII]. Note that this approach is applicable to households as well as to firms.

"double coincidences"—of buyers who want exactly what the seller has to offer—on which successful barter is based. Hence the entrance of money into the production function reflects the fact that it frees labor and capital for the production of commodities proper. This is an alternative expression of the greater specialization and exchange which money makes possible. At the same time, we continue with the assumption that money is of the outside type, without any costs of production or administration.

In any event, an immediate implication of our present approach is that the imputed services of money balances should *not* be included in disposable income. For these services are already reflected in the increased output of commodities which these balances make possible, so that it would be double counting to take account of them again in our definition of income.<sup>27</sup> On the other hand, the changes in the real value of cash balances generated by changes in the price level should be reflected in disposable income; for even though all money balances are assumed to be held by firms, these gains and losses can be assumed to be passed on to households. Hence the definition of disposable income is once again that specified in equation (1) above. Similarly, and in analogy to (2), the rate of capital accumulation is

$$(42) \quad \dot{K} = G\left(K, L, \frac{M}{p}\right) - (1-s) \left[ G\left(K, L, \frac{M}{p}\right) + \frac{M}{p}(\mu - \pi) \right].$$

Under steady-state assumption (10), this can be written in the intensive form

$$(43) \quad sg(k, m) + (s-1)mn = nk,$$

where  $y = g(k, m)$  is obtained from the foregoing production function by dividing it through by  $L$ . Note that equation (43) can be rewritten as

$$(44) \quad \left[ s + \frac{(s-1)mn}{g(k, m)} \right] g(k, m) \equiv \sigma^*(k, \pi)g(k, m) = nk,$$

where, as the reader can readily verify,  $\sigma^*(k, \pi) = s + (s-1)mn/g(k, m)$  is the appropriate physical-savings ratio. Thus (44)—and hence (43)—are entirely analogous to (4).

On the other hand, we are no longer free to describe the demand for money balances by equation (3). For the treatment of these balances as a factor of production implies that the demand for them is determined by the marginal productivity principle. Now, the marginal advantages which a firm obtains from holding a unit of real money balances consists not only of its marginal physical product, but also of the marginal

<sup>27</sup> [14, pp. 160-61].

capital gains,  $-\pi$ , that can be earned by virtue of any anticipated price decline.<sup>28</sup> Hence, since the prices of physical capital and real balances are, by definition, each equal to unity, the relevant marginal condition is

$$(45) \quad g_k(k, m) = g_m(k, m) - \pi$$

where  $g_k(\cdot)$  and  $g_m(\cdot)$  are the partial derivatives of  $g(\cdot)$  with respect to  $k$  and  $m$ , respectively.

In general—and even in the case of a simple, Cobb-Douglas production function—equation (45) cannot be solved explicitly for the demand for real balances  $m$  as a function of  $k$  and  $\pi$ . Nevertheless, by implicit differentiation of (45) it is possible to show that the partial slopes of  $m$  with respect to these variables have respectively the same signs as in (3)—or, rather, (23).

For this purpose let us first define the function

$$(46) \quad \psi(m, k, \pi) \equiv g_k(k, m) - g_m(k, m) + \pi,$$

whose partial derivatives are thus

$$(47) \quad \begin{aligned} \psi_m &= g_{km} - g_{mm} \\ \psi_k &= g_{kk} - g_{mk} \\ \psi_\pi &= 1, \end{aligned}$$

where  $g_{km}$ ,  $g_{kk}$ , etc. are the respective second-order partial derivatives of  $g(\cdot)$ , and where by the assumption of continuity  $g_{km} = g_{mk}$ . By the assumption of diminishing marginal productivity,  $g_{kk}$  and  $g_{mm}$  are both negative. Under the further assumption that the factors are cooperant (as is, for example, the case with a Cobb-Douglas function),  $g_{km} = g_{mk}$  is positive. Using these assumptions in (47) implies  $\psi_m > 0$  and  $\psi_k < 0$ . Differentiating (46) partially implicitly then yields

$$(48) \quad \frac{\partial m}{\partial k} = - \frac{\psi_k}{\psi_m} > 0$$

and

$$(49) \quad \frac{\partial m}{\partial \pi} = - \frac{\psi_\pi}{\psi_m} < 0.$$

As the reader can verify, these are also the signs of the corresponding slopes of demand function (23).

Returning now to the definition of disposable income in the present case, we note that from one viewpoint it is actually closer to definition

<sup>28</sup> Cf. footnote 2 above.



(5). For substituting from (45) into (1) we obtain

$$\begin{aligned}
 (50) \quad Y_D &= Y + \frac{M}{p} (\mu - \pi) \\
 &= Y + \frac{M}{p} (\mu + g_k - g_m) = Y + \frac{M}{p} (\mu + r - g_m).
 \end{aligned}$$

Thus just as in the case where money is treated as a consumer's good, the definition of disposable income can be written without explicit reference to  $\pi$ . The interpretation of this is analogous to that presented in connection with definition (5): since the price rise is anticipated, the loss it generates in the real value of money holdings must (at the margin) just equal (and hence be representable by) the net gains in production that these holdings make possible—which in the present case equals  $g_m - g_k$ .

The steady-state values of  $k$  and  $m$ —for any given value of  $\pi$ —are, of course, obtained by the simultaneous solution of (43), (45). Clearly, per capita output in this steady state will be greater than or equal to the corresponding output in a barter economy with the same level of  $k$ : for firms in the monetary economy always have the option of carrying out production without the use of money.

11. As before, our major concern is to analyze the effect on the steady-state values of  $k$  and  $m$  of a change in  $\mu$  and hence  $\pi$ . If (45) could be solved for the demand for  $m$  as a function of  $k$  and  $\pi$ , then this function could be substituted in (43) and the analysis could proceed as in Sec. 4-5 above. As we have however already noted, in general such a solution cannot be obtained. We can therefore only resort to an implicit differentiation of system (43), (45) with respect to  $\pi$ .

Assuming for simplicity that  $s$  is constant and carrying out this differentiation, we obtain the system of equations

$$(51) \quad [sg_k - n] \frac{dk}{d\pi} + [sg_m + (s-1)n] \frac{dm}{d\pi} = 0,$$

$$(52) \quad [g_{mk} - g_{kk}] \frac{dk}{d\pi} + [g_{mm} - g_{km}] \frac{dm}{d\pi} = 1.$$

Solving by use of determinants then yields

$$(53) \quad \begin{array}{cc} dk & sg_m + (s-1)n \\ d\pi & -\Delta \end{array}$$

and

$$(54) \quad \frac{dm}{d\pi} = \frac{sg_k - n}{\Delta}$$

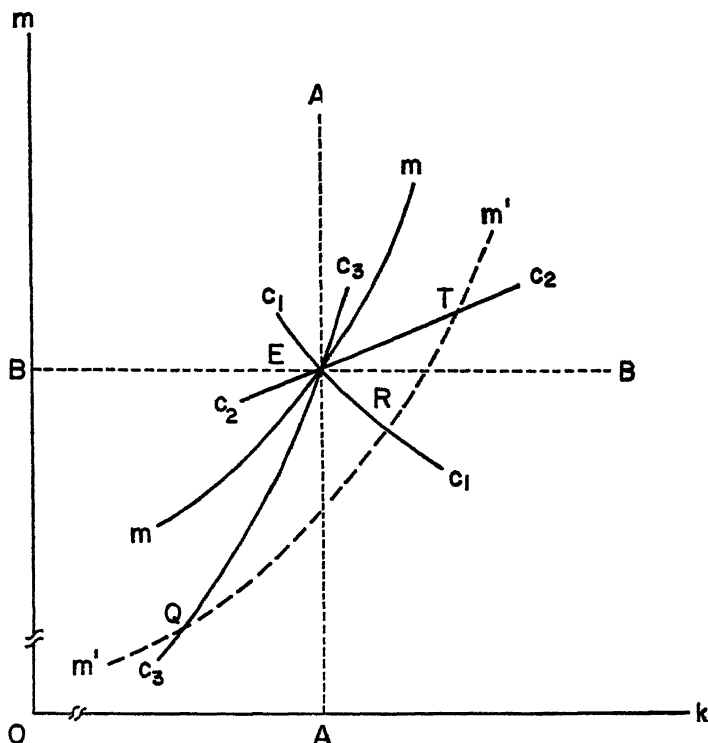


FIGURE 3

where

$$(55) \quad \Delta = [sg_k - n][g_{mm} - g_{km}] - [sg_m + (s-1)n][g_{mk} - g_{kk}].$$

As the reader can readily verify, the assumptions made in connection with (47) above are not sufficient to determine the signs of the expressions  $sg_k - n$  and  $sg_m + (s-1)n$ , and hence of the derivatives (53)–(54). This indeterminacy is interpreted graphically in Figure 3. The curve  $mm$  in this diagram represents the locus of all points which satisfy (45) for a given value of  $\pi$ . By (52)—or (49)—its slope is positive. On the other hand, the slope of the curve representing (43)—which can be seen from (51) to be equal to  $-[sg_k - n]/[sg_m + (s-1)n]$ —cannot be specified a priori. Correspondingly, in the neighborhood of the original long-run equilibrium position  $E$ , the slope of curve (43) can be either negative ( $c_1c_1$ ) or positive—and in the latter case it can cut  $mm$  from either above ( $c_2c_2$ ) or below ( $c_3c_3$ ). Now, by (49) an increase in  $\pi$  causes a downward shift in  $mm$  to (say)  $m'm'$ . On the other hand, it is clear from (43) that it does not affect the  $cc$  curve. Hence the effect of such a shift on the steady-state values of the system depends on the shape of  $cc$ , and on

whether accordingly the system is brought to point  $Q$ ,  $R$ , or  $T$ . Furthermore, as we shall see below in terms of a different graphical analysis, the correspondence principle does not enable us to eliminate any of these alternatives.

Despite this indeterminacy, there are two analogies that might be noted between the foregoing results and those obtained in the case where money was assumed to be a consumer's good. First, we saw from (20) and (22) that even for a constant  $s$ , the sign of  $dk/d\pi$  could not be determined without making some assumption as to the elasticity of demand for money, and this is analogous to the influence of  $g_m$  on the sign of  $dk/d\pi$  in (53). Second, from the fact (demonstrated in the preceding section) that the slopes of the demand function for money have the same signs, whether it is considered a consumer's or producer's good, it follows that there are also certain common relationships between the signs of  $dm/d\pi$  and  $dk/d\pi$ . In particular, differentiating the excess-demand equation for money,  $\psi(m, k, \pi) = 0$ , totally with respect to  $\pi$ , we obtain

$$(56) \quad \psi_m \frac{dm}{d\pi} + \psi_k \frac{dk}{d\pi} + \psi_\pi = 0,$$

which we rewrite as

$$(57) \quad \frac{dm}{d\pi} = -\frac{\psi_k}{\psi_m} \frac{dk}{d\pi} - \frac{\psi_\pi}{\psi_m}.$$

The equality between the signs of the slopes of the money-demand functions as shown in (48)–(49) means that in both cases  $-\psi_k/\psi_m > 0$  and  $-\psi_\pi/\psi_m < 0$ . Hence in both cases if  $dk/d\pi \leq 0$ , then  $dm/d\pi < 0$ ; and if  $dm/d\pi \geq 0$ , then  $dk/d\pi > 0$ . On the other hand, if  $dk/d\pi > 0$ , then the sign of  $dm/d\pi$  is indeterminate; similarly, if  $dm/d\pi < 0$  then the sign of  $dk/d\pi$  is indeterminate.

These relationships have already been noted in the preceding case in connection with the discussion of equation (23). They can also be directly derived from Figure 3. If the increase in  $\pi$  decreases  $k$  (i.e., generates a new equilibrium position on  $m'm'$  leftwards of the vertical line  $AA$ ), then it must also decrease the equilibrium value of  $m$ . On the other hand, if it shifts the system to an equilibrium position rightwards of  $AA$ , then nothing can be said about the direction of change in  $m$ . Corresponding statements can be made, *mutatis mutandis*, for shifts to equilibrium positions above and below the horizontal line  $BB$ .

Let us now see if it is possible to make some additional "reasonable" assumptions that will enable us to determine the signs of derivatives (53)–(54). Consider first  $sg_m + (s-1)n$  and let us divide it through by

$g_m$ , thus yielding  $s+(s-1)n/g_m$ . From (42) and (10) we know that total steady-state physical savings in the present model are

$$(58) \quad \begin{aligned} \dot{K} = S_P &= Y - (1-s) \left( Y + \frac{M}{p} n \right) \\ &= sY + (s-1) \frac{M}{p} n. \end{aligned}$$

The addition to physical savings when physical income increases is then

$$(59) \quad \frac{\partial S_P}{\partial Y} = s + (s-1) \frac{\partial \left( \frac{M}{p} \right)}{\partial Y} n.$$

This can be assumed to be positive, though—unlike the situation with respect to the physical-savings ratio  $\sigma$ —this is *not* a necessary characteristic of the steady state. Now the derivative  $\partial(M/p)/\partial Y$  can be interpreted as the additional real balances needed for an additional unit of output, which is nothing else but the reciprocal of  $g_m$ . It then follows that  $s+(s-1)n/g_m$ , and hence  $sg_m+(s-1)n$ , can be assumed to be positive.

This, however, does not enable us to determine the signs of the derivatives in (53)–(54). Because for different—though quite “reasonable”—values of the variables, the expression  $sg_k n$ —and hence the slope of  $cc$  in Figure 3—can be either positive or negative.

We also note that this indeterminacy is not removed by assuming that the system is stable. As will be shown in the next section, under the assumption of a compensatory monetary policy which keeps  $\pi$  constant, such stability once again means (in terms of Figure 1) that the physical-savings curve  $z = \sigma^*(k; \pi_0)g(k, m)$  [see equation (44)] cuts the ray  $nk$  from above. Hence at the level of  $k$  corresponding to long-run equilibrium position  $A$  in Figure 1, a change in  $\pi$  will cause the physical-savings curve to shift vertically by an amount equal to

$$(60) \quad \frac{dz}{d\pi} = \sigma^*(k, \pi)g(k, m) + \sigma^*(k, \pi)g_m(k, m) \frac{\partial m}{\partial \pi}.$$

From the definition of  $\sigma^*$  in (44) we obtain  $\sigma^*_\pi = [(s-1)s/g^2](g - mg_m) \cdot \partial m / \partial \pi$ . Since this expression is being evaluated for a fixed value of  $k$ , it follows from (49) that  $\partial m / \partial \pi < 0$ . By the assumed nature of the production function, we also have that output  $g$  exceeds factor-share  $mg_m$ . Thus  $\sigma^*_\pi$ —and hence the first term of (60)—is positive. In terms of §5, this reflects the fact that under our present definition of disposable income and assumed constancy of  $s$ , an increase in  $\pi$  causes only a positive

composition effect. But in contrast with §5, it is no longer true that  $\text{sign } dz/d\pi = \text{sign } \sigma_{\pi}^*$ . For the decrease in  $m$  generated by the increase in  $\pi$  also decreases the output out of which physical savings are made; and this is represented by the second—and negative—term in (60). Thus whether the physical savings curve  $\sigma g(k, m)$  rises or falls in the neighborhood of point  $A$ —and whether, accordingly,  $dk/d\pi$  is positive or negative—depends on which of these two forces predominates.

For much the same reason it can be shown that, unlike the situation in Sec. 6 above, this indeterminacy continues to prevail even for a “large” price decrease. For the equality between the real rate of interest and the marginal productivity of capital is now expressed by the relation  $r = g_k(k, m)$ ; hence there exists a curve  $QQ$  for every value of  $m$ . Once again, as shown by (49), the greater the rate of price decrease, the greater the demand for money  $m$  as of any given level of  $k$ ; hence (assuming the factors to be cooperant) the more the marginal productivity curve  $QQ$  shifts leftwards in Figure 2. Hence the fact that  $QQ$  is asymptotic to the  $Z$ -axis as of a given value of  $m$  does not enable us to draw any inferences about the behavior of  $EE$  as  $\pi$  decreases indefinitely.

In a similar way it can be shown that—in contrast with the situation at the end of Sec. 5 above—the steady-state level of  $k$  will be affected by a change in  $\pi$  even in the case in which the savings function is derived from maximizing utility over an infinite time horizon at a constant rate of subjective time preference  $\delta$ . For the necessary equality between the marginal productivity of capital and  $\delta + n$  in this case is expressed by the equation  $g_k(k, m) = \delta + n$ , which no longer fixes the value of  $k$ .<sup>29</sup>

12. Let us continue to assume that  $s$  is constant, and consider the stability properties of the model. Dividing (42) through by  $K$  and converting it to the intensive form yields the differential equation

$$(61) \quad \frac{\dot{k}}{k} = s \frac{g(k, m)}{k} + (s - 1) \frac{m}{k} (\mu - \pi) - n.$$

For simplicity, let us again restrict the analysis to the case in which the monetary authorities continuously adjust  $\mu$  so as to keep  $\pi$  constant throughout the dynamic process. The implications of this policy in the present case can be seen by first differentiating (45) with respect to time under the assumption that  $\pi$  is constant at  $\pi_0$  to yield

$$(62) \quad (g_{kk} - g_{mk})\dot{k} + (g_{km} - g_{mm})\dot{m} = 0,$$

<sup>29</sup> Since writing this section we have learned that Uzawa [23] has presented a growth model in which money enters the production function. Uzawa derives savings behavior from utility maximization and is thus able to determine the sign of  $dm/d\pi$  as negative and  $dr/d\pi$  as positive; but the sign of  $dk/d\pi$  remains indeterminate.

and then making use of the fact that, by definition,

$$(63) \quad \frac{\dot{m}}{m} = \mu - \pi - n.$$

Substituting accordingly from (62) into (63) we see that the necessary rate of change of the money supply at any instant of time is

$$(64) \quad \begin{aligned} \mu &= \pi_0 + n + \frac{\dot{m}}{m} \\ &= \pi_0 + n + \frac{k}{m} \frac{g_{kk} - g_{mk}}{g_{mm} - g_{km}} \frac{\dot{k}}{k}. \end{aligned}$$

Substituting from (64) into (61) and collecting terms then yields the differential equation of the system as a whole

$$(65) \quad \frac{\dot{k}}{k} = \frac{s \frac{g(k, m)}{k} + (s-1) \frac{m}{k} n - n}{H(k, m)},$$

where

$$(66) \quad H(k, m) \equiv 1 + (1-s) \frac{g_{kk} - g_{mk}}{g_{mm} - g_{km}}.$$

Once again, the system is stable in the small if and only if

$$(67) \quad \frac{d\left(\frac{\dot{k}}{k}\right)}{dk} < 0$$

when evaluated at the steady-state position. Now, by (44) the numerator of (65) is zero at this position, while the denominator is always positive. Hence, by the same argument as in Sec. 7 above, we have

$$(68) \quad \text{sign} \frac{d\left(\frac{\dot{k}}{k}\right)}{dk} = \text{sign} \frac{d \left[ s \frac{g(k, m)}{k} + (s-1) \frac{m}{k} n - n \right]}{dk} \\ = \frac{k g_k - g}{k^2} + \frac{s g_m + (s-1)n}{k} \frac{\partial m}{\partial k} \frac{(s-1)mn}{k^2} \Bigg],$$

where  $\partial m / \partial k > 0$  by (48). Since the share of any factor is assumed to be

less than the whole (i.e., every factor has a positive marginal product), the term  $kg_k - g$  is negative. (This is actually the argument which also lies behind the negative sign of  $a'(k)$  assumed in Sec. 5 above.) But this is not enough to determine the sign of the right-hand side of (68), which might be positive. Thus the stability of the present model cannot be unequivocally affirmed even under the simplifying assumptions of a constant  $s$  and  $\pi$ .

This possible instability can be interpreted economically as follows: A chance increase in  $k$  ( $m$  constant) will decrease average output in the usual manner, and thus tend to be self-corrective; this is represented by the negative expression  $s(kg_k - g)/k^2$  in (68). But  $m$  cannot remain constant; for the increase in  $k$  decreases the real—and therefore money—rate of interest and thus generates an increase in the input of  $m$ . (See equation (48).) Hence average output and hence physical savings will tend to increase. It follows that if this latter influence is sufficiently strong (i.e., if  $g_m$  is sufficiently large),  $k$  will be driven ever farther away from its original steady-state value.

We note finally that the foregoing stability condition is once again capable of a simple graphical interpretation. In particular, by applying the argument at the end of Sec. 7 above, it can be shown that the right-hand side of (68) will be negative if and only if the physical savings curve  $z = \sigma^*(k; \pi_0)g(k, m)$  defined by (44) intersects the ray  $nk$  from above. As we have seen, however, in our discussion of equation (60), this fact does not enable us to determine the comparative-dynamics properties of the system.

13. Consider finally the implications of the present model for optimum growth in the sense of Sec. 9. As in the analysis of that section we distinguish between the case in which the policy authorities control both  $\mu$  (and hence  $\pi$ ) and  $s$ , and the case in which they control only  $\mu$ .

The entrance of money into the production function does not change the basic fact that the level of per capita investment (physical saving) necessary to maintain a constant capital-labor ratio is  $nk$ . Hence any steady-state level of consumption,  $c$ , must satisfy the relationship  $c = g(k, m) - nk$ . By taking the differential of this function, the reader can establish (along the lines of Sec. 9 above) that a government which has at its disposal the policy parameters  $\pi$  and  $s$  will maximize  $c$  by choosing values of these parameters—and thereby  $k$  and  $m$ —which simultaneously satisfy the Golden Rule (which in the present case has the form  $g_k(k, m) - n = 0$ ), and satiate money balances (i.e.,  $g_m(k, m) = 0$ ). Equation (45) then implies  $-\pi = n$ , from which it follows once again that optimum policy calls for keeping the quantity of money constant.

As before, a more interesting question is the nature of optimum policy when the authorities control only  $\pi$ . The necessary condition for maxi-

mum steady-state consumption, namely

$$(69) \quad \frac{dc}{d\pi} = g_k \frac{dk}{d\pi} + g_m \frac{dm}{d\pi} - n \frac{dk}{d\pi} = 0$$

(which is seen to be similar to (41)), then implies that the ordinary Golden Rule will not be valid except in the special case where  $dm/d\pi = 0$ . Generally, however, per capita consumption can be increased when  $g_k = n$  by changing  $\pi$  so as to increase  $m$  and thereby per capita production. Similarly, only in the case in which  $dk/d\pi = 0$  will maximum welfare imply the holding of cash balances which are so large that  $g_m = 0$ . The interpretation of these results is entirely analogous to the one presented of the corresponding results in Sec. 9 above—including the restrictive sense in which “optimum” is being used here.

Actually, equation (69) can be interpreted as a generalized form of the Golden Rule.<sup>30</sup> Specifically, a necessary condition that a policy parameter be at its optimum steady-state value is that any differential change in the parameter generate an increase in per capita capital and hence output ( $dy$ ) which is just equal to the increased output that must be devoted to maintaining a constant capital-labor ratio ( $ndk$ ): for if the former should exceed (fall below) the latter, it would be possible to increase steady-state consumption by changing the parameter so as to increase (decrease)  $k$ . It is this necessary condition which is reflected in the requirement of (69) that  $dy/d\pi = g_k(dk/d\pi) + g_m(dm/d\pi) = n(dk/d\pi)$ .

By making use of the results of Sec. 11, we can greatly simplify equation (69). In particular, substituting from (53)–(54) into (69) reduces the latter to  $g_k - g_m = n$ . From (45) it then follows that  $-\pi = n$ , which in turn implies  $\mu = 0$ . Thus constancy of the nominal quantity of money represents optimal monetary policy even in the case in which the government controls only  $\mu$ ! On the other hand, this constancy does not have the same connotation in this case as in the preceding one. For since under our present assumptions the Golden Rule  $g_k - n = 0$  does not generally obtain, neither does satiety of money balances  $g_m = 0$ . Correspondingly, the real rate of interest in this optimum will generally be greater than  $n$ , and hence the money rate of interest greater than zero.

If we now make use of the relation  $g_k - g_m = n$  in (69), we see that it implies that  $dk/d\pi = -dm/d\pi$  in the optimum steady-state. This in turn reflects a more basic relationship that obtains in the present model (as well as, *mutatis mutandis*, in the ordinary Solow model) for any

<sup>30</sup> The remainder of this section represents the outcome of extremely helpful discussions at M.I.T., in which James Mirrlees first pointed out how (69) could be simplified by substitution from (53)–(54), and Robert M. Solow and C. Christian von Weizsäcker then interpreted the result by showing that the model was characterized by the underlying relationship (70). We are greatly indebted to them for their most valuable help.



steady state. In particular, substituting  $g(k, m)$  from steady-state condition (43) into the definition of steady-state consumption  $c = g(k, m) - nk$  yields

$$(70) \quad c = \frac{1-s}{s} n(k+m).$$

That is, per capita steady-state consumption is proportionate to per capita total wealth,  $k+m$ . Hence  $c$  is maximized with respect to  $\pi$  when this wealth is also so maximized, which means  $dk/d\pi + dm/d\pi = 0$ . And from this fact we could then directly deduce from (69) that the optimum steady state is characterized by the relation  $g_k - g_m = n$ .

Note that this relation obtains only on the assumption that  $s$  is constant. In the more general case in which  $s$  depends on  $r = f'(k)$ —and a fortiori in the case in which it depends also on  $-\pi$ , as in (17) above—maximum consumption would not generally coincide with maximum wealth in (70). Correspondingly, we would then have to remain with the general optimum relationship described by (69).

We note finally that since the analysis of Sec. 9 deals with the maximization of utility derived from two separate goods, the foregoing argument cannot be carried over to it—even under the assumption of a constant  $s$ .

#### IV. *Some Concluding Remarks*

14. The analysis of this paper has been presented as dealing with the effects of the rate of monetary expansion on the growth path of the system. Actually, however, its concern has been with a monetary expansion used by the government in one specific way—namely, to finance transfer payments. Indeed, these transfer payments,  $\mu(M/p)$ , appear as a component of disposable income both in definition (1) and in definition (5).

This suggests that the effects of a monetary expansion differ in accordance with the use which the government makes of the money which it prints. Let us illustrate this point by considering the model of Part II and assuming that the government uses the newly issued money for three different purposes: transfer payments, consumption (expenditures from the current budget on goods and services), and investment (corresponding expenditures from the development budget). Let the respective proportions in which the money is spent for these purposes be  $q_T$ ,  $q_C$ , and  $q_D$ , where, of course, all the  $q$ 's are greater than or equal to zero and  $q_T + q_C + q_D = 1$ . (We deal only with the case of a monetary expansion; in the case of a monetary contraction,  $q_C = q_D = 0$  and  $q_T = 1$ , by definition.)

An immediate implication of these assumptions is that the definition

of disposable income is now

$$(71) \quad Y_D = Y + q_T \mu \frac{M}{p} - \pi \frac{M}{p} + \frac{M}{p} (r + \pi) \\ = Y + q_T \mu \frac{M}{p} + r \frac{M}{p}.$$

That is, income from transfer payments is only  $q_T \mu (M/p)$ ; on the other hand, the loss on real balances generated by a price change and the imputed income from the services of these balances remain the same as before. It follows that the equilibrium condition in the commodity market is now—instead of (6)—

$$(72) \quad (1 - s) \left[ F(K, L) + q_T \mu \frac{M}{p} + r \frac{M}{p} \right] \\ + q_C \mu \frac{M}{p} - \frac{M}{p} (r + \pi) + \dot{K} = F(K, L),$$

where  $q_C \mu (M/p)$  represents the government's real demand for consumption commodities. Note that the government's demand for investment commodities does not appear separately in the equation, for it is already included in  $\dot{K}$ .

Substituting the money demand function (7) into (72) and carrying out similar operations to those used in Sec. 4, we can reduce (72) to the form (18), which we rewrite as

$$(73) \quad \frac{f(k)}{k} \equiv a(k) = \frac{n}{\sigma(k; \pi, q_T, q_C)},$$

where

$$(74) \quad \sigma = s \{ 1 + \lambda [q_T(n + \pi) + r] \} - \lambda [(q_T + q_C)(n + \pi) - \pi].$$

Correspondingly, the effect of a change in  $\pi$  on  $k$  is again given by (20), which we rewrite for convenience as

$$(75) \quad \frac{dk}{d\pi} = \frac{\sigma_\pi}{-\frac{\sigma^2}{n} a'(k) - \sigma_k},$$

where now

$$(76) \quad \sigma_k = f''(k) \{ s_1 [1 + \lambda [q_T(n + \pi) + r]] + s [\lambda' [q_T(n + \pi) + r] + \lambda] \\ - \lambda' [(q_T + q_C)(n + \pi) - \pi] \}$$

and

$$(77) \quad \sigma_{\pi} = -s_2\{1 + \lambda[q_T(n + \pi) + r]\} + s[\lambda'[q_T(n + \pi) + r] + \lambda q_T] \\ - \lambda'[(q_T + q_C)(n + \pi) - \pi] - \lambda[q_T + q_C - 1].$$

Clearly, these last three expressions reduce respectively to (16), (21a), and (22) for the special case in which  $q_T = 1$  and  $q_C = q_D = 0$ . As the reader can verify, the assumptions made above in connection with the latter equations are not sufficient to determine the signs of  $\sigma_k$  and  $\sigma_{\pi}$  here.

The foregoing expresses the obvious fact that under the stated assumptions both the sign and magnitude of  $dk/d\pi$  depends on the policy parameters  $q_T$ ,  $q_C$ , and (by implication)  $q_D$ . A much more significant (though equally obvious) fact is that by *changing* these parameters, the government can generate a monetary expansion with any desired effect on  $k$ . Thus assume that the government accompanies the monetary expansion with a change in the proportion of the new money devoted to current and development expenditures, respectively, while keeping constant the proportion devoted to transfer payments. Then the effect of such a policy is determined by differentiating (73) implicitly with respect to  $\mu$  to yield

$$(78) \quad \frac{dk}{d\mu} = \frac{\sigma_{\pi} + \sigma_{q_C} \frac{dq_C}{d\mu}}{-\frac{\sigma^2}{n} a'(k) - \sigma_k},$$

where from the partial differentiation of (74)

$$(79) \quad \sigma_{q_C} = -\lambda(n + \pi)$$

and where we have made use of the assumption that  $dq_T/d\mu = 0$  and of the fact that, by (10),  $d\pi/d\mu = 1$  in the steady state. Clearly, then,  $dk/d\mu$  depends on the way in which the government simultaneously changes  $q_C$ , as represented by  $dq_C/d\mu$ .

Thus consider the case in which the government wishes to generate a neutral monetary expansion, in the sense of leaving  $k$  invariant. The required change in  $q_C$  (and hence  $q_D$ ) can then be derived from (78) by setting the left-hand side equal to zero and obtaining

$$(80) \quad \frac{dq_C}{d\mu} = \frac{\sigma_{\pi}}{\sigma_{q_C}} = \frac{\sigma_{\pi}}{\lambda(n + \pi)}.$$

Thus if  $\sigma_k$  is negative so that—in the absence of any change in  $q_C$ —sign  $dk/d\pi$  would equal sign  $\sigma_{\pi}$  by (75); and if  $\sigma_{\pi}$  is positive, so that  $k$  would otherwise increase with an increase in  $\mu$ ; then equation (80) makes the obvious statement that the government must increase the proportion of its expenditures on consumption goods (i.e., decrease the proportion on

investment goods) in order to keep  $k$  constant in the face of a monetary expansion<sup>31</sup>

Note that the government can influence  $k$  even if it does not have a development budget. For assume that  $q_T + q_C = 1$ . This does not affect (78); but it does cause (79) to be replaced by

$$(81) \quad \sigma_{q_C} = -\lambda s(n + \pi),$$

and (80) accordingly by

$$(82) \quad \frac{dq_C}{d\mu} = \frac{\sigma_T}{\lambda s(n + \pi)}$$

Since  $s < 1$ , this means that in order to increase  $\mu$  and yet leave  $k$  constant, the government will have to increase its expenditures on consumption goods relatively more in the present case than in the preceding one. The explanation is straightforward: An increase in government consumption in the preceding case meant a corresponding decrease in government investment; but the increase in government consumption in the present case is solely at the expense of transfer payments, and hence is in part offset by the resulting reduction in disposable income and hence private consumption.

In brief, even if the government does not itself carry out investment, it can affect the level of capital intensity in the economy by varying the proportion of its budget devoted to the consumption of goods and services as against transfer payments. For by shifting from the latter to the former it essentially transfers disposable income from units (households) whose marginal propensity to consume is less than unity to a unit (the government) whose propensity is unity; hence it increases the overall ratio of physical consumption (decreases the overall ratio of physical savings) and thus tends to decrease the level of  $k$ .<sup>32</sup>

We note too that the entire argument of this paper has been based on the assumption that all money is issued by the government and is therefore of the outside variety. In order to analyze an economy with inside money as well, we would have to introduce into the model a bond (or loan) market which would reflect the deposit-creating activities of the banking sector. We would also have to take account of the costs of these activities. In particular, whether money was considered a consumer's or producer's good, the production function would have the general form

$$(83) \quad H\left(K, L, \frac{M}{p}, Y\right) = 0,$$

<sup>31</sup> Note that a necessary condition for such a policy to be feasible is that the economy is not initially at a position in which  $q_C = 1$ .

<sup>32</sup> There is an obvious analogy here to the balanced-budget-multiplier argument.

reflecting the fact that capital and labor were also used up in maintaining the financial structure which generated real money balances.

Of particular theoretical interest is the case of a pure inside-money economy: that is, one in which the entire money supply is created by the credit-extending activities of the banking system.<sup>33</sup> From our observations of the real world, it seems only reasonable to assume that the bonds of any economy experiencing a constant rate of price change would have an "escalator clause" tying the principal and interest payments to the price index. And just as the banks would insist on such a clause on the loans they made, so individuals would insist upon it with reference to their demand deposits—thus assuring that they would not suffer any capital losses as a result of price increases. In more formal terms, these capital losses would be automatically offset by the *explicit* rate of return  $\pi$  which demand deposits would earn. Correspondingly, under these assumptions the alternative cost of holding money would be  $r$ , and not  $r + \pi$ . More generally, there would be no asset in the economy with a real rate of return of  $-\pi$ . Furthermore, in such an economy, the government—by definition—issues no money; hence the component of disposable income which represents government transfer payments made with newly issued money ( $\mu M/p$ ) would be zero.

From all this it follows that in a pure inside-money economy, the behavior of individuals would not be affected either by the rate of expansion of the money supply,  $\mu$ , or by the rate of price change,  $\pi$ . Hence the system is neutral—with respect to *all* real variables—in the second sense indicated in Sec. 8 above. Similarly, the system is neutral in the first sense: for its dependence on  $M/p$  means that if the nominal quantity of money is (say) twice as high as before, then a price level which is also twice as high will enable the system to return to equilibrium with all the real variables having the same values as before.

We note finally that we have dealt in this paper with two extreme cases: one in which money is only a consumption good and one in which it is only a producer's good. However, money can be assumed to fulfill both these roles simultaneously. In particular, whereas money holdings of firms lend themselves to analysis via the production function, those of households lend themselves—at least in part<sup>34</sup>—to analysis via the utility function. Hence a truly general model would analyze the total demand for money from both these viewpoints.

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<sup>33</sup> Cf. on this discussion Gurley and Shaw [6]; Patinkin [14, Ch. XII:5].

<sup>34</sup> The proviso is necessitated by the comment in footnote 26 above.

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## INCENTIVE AND DISINCENTIVE EXPERIMENTATION FOR INCOME MAINTENANCE POLICY PURPOSES

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Man's progress on the technological front has been enormous, but in spite of this—or in part even because of this—his progress on the social front seems dangerously inadequate. Nor does it appear that present research in the physical and biological sciences, valuable as it is, is likely to contribute more than marginally to the solution of those social problems which man must solve if he is to have a continued and attractive footing on this planet.

To create the world of his dreams man must learn to control himself, and he must learn to do so in a way which is compatible with his values. A deeper knowledge of individual and social behavior seems essential, for this. We need a development of the social sciences directed towards finding how to utilize and control the forces put into our hands by the physical and biological sciences. We need to know how incentives and disincentives, for instance, can be used to keep our social behavior under reasonable control without the sacrifice of values which are central to our well-being.

Policy makers in our social institutions are able to exert control over certain variables; they are expected to achieve some control over still other variables. It follows that policy makers need to know how these other variables are related to the variables which they do know how to regulate.

For instance policy makers know how to set minimum wage rates, and they need to know how the employability and earned income of individuals are affected by changes in these rates. They know how to legislate a personal income tax law, and they need knowledge of how

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labor force participation, occupation and job choice, effort, and productivity depend upon such things as the level and progressivity of taxation. Policy makers know ways of legislating a guaranteed minimum income for individuals or families, and they need to know how participation in the labor force and earned income of individuals would be affected by this guaranteed income. Also, they may want to know things such as how fertility, family composition, nurture, and education of children would respond to such a change.

By virtue of taxing, spending, loaning, and regulatory powers, governmental policy makers are in a position to modify the incentives and disincentives brought to bear on individuals, families, firms, and other groups. Presumably government policy makers know, or can ascertain, suitable objectives. But do they know how to reach these objectives? The physical means appear at hand, but how can the means be mobilized? What is needed from the social sciences are guide lines for how policy tools such as incentives and disincentives could be used to bring about our dreams, in place of nightmares.

In Section I we present the basis for hoping that well-designed experiments could assist in reducing ignorance about effects that would follow from the introduction of new economic policies or programs. In Section II we seek to encourage the idea that an experimental approach is feasible by discussing three of the primary reasons why many economists have ruled out any serious consideration of experimentation as a research approach which they might use. Sections III, IV, and V deal briefly with the choice of experimental variables, experimental units, and methods of analysis. Section VI suggests ways in which relevance of experimentation to policy issues may be enhanced. This section thus represents a natural extension of the discussion in Section II on feasibility of an experimental approach. Section VII presents some economizing possibilities and thus also represents an extension of Section II. Recommendations are presented in the final section.

### *I. Whys and Whats of an Experimental Approach<sup>1</sup>*

Given that policy makers need more knowledge of the results of using available incentives and disincentives, how can the social sciences

<sup>1</sup> This paper focuses on issues that should be understood and faced up to by economists or other social scientists interested in carrying out social experimentation. However, the problem of designing an efficient experimental plan is a rather specialized one and certainly calls for the services of a statistician especially skilled in this area. The serious student will find that the following books provide an excellent introduction to the statistical literature on the design of analysis of experiments: W. G. Cochran and G. M. Cox, *Experimental Designs*, 2nd Ed., New York 1957; D. R. Cox, *Planning of Experiments*, New York 1958; W. T. Federer, *Experimental Design*, New York 1955; R. A. Fisher, *The Design of Experiments*, 7th ed., New York 1960; O. Kempthorne, *The Design and Analysis of Experiments*, New York 1952; H. B. Mann, *Analysis and Design of Experiments*, New York 1949; K. C. Peng, *The Design and Analysis of Scientific Experiments*, Reading, Mass., 1967.



meet this need? The research problem is a general one but, in the interest of clarity, we shall discuss it in a specific context.

Among the various income maintenance proposals which have been made, negative income tax proposals are receiving a great deal of attention and support. These proposals appear to hold great promise, but important questions remain unanswered. Uncertainty may lead to an indefinite delay in implementing a program which could become a milestone in our struggle with poverty.

Experimentation for policy purposes is needed to attack questions of interest to policy makers. Hence, with regard to negative tax experimentation researchers might begin by asking: "What are the concerns of policy makers?" Hundreds of questions come to mind, of course. Some have to do with administrative methods. Others revolve around the possibility of changes in labor conditions. From our standpoint, however, the most interesting group of questions are those concerning the responses of the people who would actually receive negative income tax transfers:

1. Does money have different incentive effects on people from different socio-economic classes?
  2. Will the substitution and income effects associated with this tax both exert their pull in favor of more leisure rather than work?
  3. Will individual work effort be affected by the level of assistance payments, the welfare tax rate or by both?
  4. Will transfers associated with a negative income tax, affect the future earning powers of the poor?
  5. On what will these transfer payments be spent?
  6. What percentage of those helped by such a program could be expected to become self-supporting?
  7. What long-range effects will these transfers have on the children of the poor?
  8. What effect does the work status of parents have on the development of their children?
  9. Should a negative tax program include some system of bonus payments to be awarded for finding and keeping a job?
  10. What can be said for group bonuses and maintenance payments?
  11. Will the stigma associated with welfare be avoided with a negative tax program? What are the implications of this stigma?
  12. What effect will this proposed tax have on family stability?
  13. What are the relationships between income level, the extent to which negative tax payments are geared to family size, and the birth rate?
  14. And finally, how might such a tax effect the mobility of the poor?
- There is general agreement that the present welfare system provides,

at best, no work incentive. President Johnson recognized this problem in his 1967 Economic Report to Congress: "With minor exceptions, payments under public assistance are reduced dollar for dollar of earnings by the recipient, removing any incentive to accept part-time work. We should encourage self-help, not penalize it. It is time to put an end to this 100 per cent tax on the earnings of those on public assistance." The need to improve upon our present welfare system seems clear. Answers to the above research questions would help in designing a better welfare system, but how are such answers to be obtained?

One highly important approach to the study of the impact of negative income tax and other income maintenance programs on earned income is the use of nonexperimental data with multiple regression techniques, in an effort to sort out the determinants of earned income of individuals and of family units. This approach has been, and should continue to be, pursued. Nevertheless, it has not yet served to eliminate our uncertainties. In part the difficulty stems from a failure to obtain, and effectively use, appropriate time series data for panels of individual and family units. Failure also may stem from difficulty in identifying historical policies which can be considered comparable with negative income tax laws. But even avoiding this, problems would remain. From the standpoint of application, not only is it important to know that two or more things are typically related; it is important also to know the direction of causation. Does individual A receive welfare payments because he has a low earned income, or does he have a low earned income because welfare payments are available to him? Or does causation run in both directions? An experimental approach could resolve this matter, and greatly reduce the area and range of uncertainty.

The basic inductive problem which faces us is that we wish to know the impact of a negative income tax law on earned income. We can observe earned income in the presence of a tax, but how can we know what earned income would have been in the absence of the tax. We can observe earned income before introduction of a negative income tax, and earned income after introduction of the tax. But can we attribute changes in earned income to the tax, or are they due to other factors which have changed in the meantime? We might observe earned income of one group before and after introduction of a tax, and earned income of a second control group not exposed to the tax over the same time period. Would it be reasonable then to ascribe the differential change of earned income of the first group relative to the second group to introduction of the tax? This would be a sensible procedure. This could lead us astray though if the characteristics of those exposed to the tax were systematically different from those not exposed either as a result of self-selection or as a result of selection by others.

A well-developed experimental approach has some problems of its own but can overcome uncertainties of the above types by virtue of our ability to draw random samples of experimental units from populations, use randomization in assignment of treatments to experimental units, and obtain unbiased estimates of population characteristics from sample characteristics.

Direct measurement of change in the earned income of any group, due solely to the introduction of a tax law, is out of the question. It is impossible simultaneously to apply, and not apply, a tax law to the same group. However, change in earned income of a group could be estimated by randomly drawing a sample from the group, and then using randomization in the assignment of tax treatments to members of this sample. In effect two non-overlapping samples would be drawn from the same group, without regard for subsequent treatment. The first of these two samples would be assigned a negative income tax; the second would not be given this treatment. Differences between the earned incomes of the two sample groups then would be due solely to sampling variability and to differences in the tax treatment. From the first sample we could obtain an unbiased estimate of what the earned income of the entire group would have been if it had been exposed to a negative income tax. From the second sample we could get an unbiased estimate of what the earned income of the same group for the same time period would have been if the entire group had not been exposed to the negative income tax. The standard error of the estimates would depend on the sample sizes, and will go to zero as the sample sizes go to infinity.

## II. *Is an Experimental Approach Feasible?*

The need for incentive and disincentive experimentation is clear, but is it feasible? Will the public accept it? Can a useful level of experimentation be financed? Can the Hawthorne effect be neutralized? Other and more specific inquiries also must be made with respect to the technical feasibility of any particular experimental plan, but uncertainties in this area do not cast doubt on the general feasibility of incentive experimentation.

### *Public Acceptance*

The experimental approach to acquisition of knowledge is eminently respectable due to the enormous success of experimentation in the physical and biological sciences. As a matter of fact, even experimentation potentially dangerous to the subjects is tolerated, and often widely lauded, if the research objectives are regarded as socially important.

Incentive experimentation, by its very nature, recommends itself for public acceptance. This kind of experimentation permits a satisfactory

disclosure of intended treatments to prospective subjects, and can be conducted in such a way as to ensure that each experimental subject makes a net gain. Furthermore, a strong case can be made for the social benefits that would follow from incentive experimentation. Disincentive experimentation poses some special problems, but even in this case it frequently would be possible to conduct experiments in such a way that each experimental subject at least makes an overall net gain.

### *Financial Feasibility*

Realistic incentive and disincentive experimentation is likely to be costly, of course, if each subject must make a net gain, and if incentives are to be varied sufficiently to enable their effects to be distinguished from the effects of environmental changes. In fact, judging from the several proposals currently being put forward for investigating income maintenance plans, it would appear that possibly several million dollars per year are needed for a moderately comprehensive and highly attractive program of systematic incentive experimentation in the United States.

Relative to the billions being spent on research in the physical and biological sciences, a few million per year seems paltry. Yet is this much feasible? To us it is obvious that incentive research is of greater social importance than an accelerator costing an initial two hundred and fifty million and requiring an annual research budget of perhaps an additional sixty million. What do policy makers controlling the availability of research funds think though? No doubt we are now rich enough to afford both kinds of research, but will we? Time will tell if our society is mature enough to use that most basic and powerful of all scientific tools, experimentation, in learning to master critical social problems.

### *The Hawthorne Effect*

As a result of a now classic set of experiments, social scientists are aware that even inference on the basis of experimental data is not always safe. In the experiments being referred to above, the experimenters thought they were investigating the effect of various kinds of environmental conditions—such as room color—on productivity. They quickly found that by altering the room color they could improve productivity. Being good scientists they investigated still farther, and found that the improved productivity could be maintained or even increased by other environmental alternations as well. They continued to alter environmental conditions, until they thought they had restored the original environmental conditions present at the start of the experiment. But, lo and behold, productivity remained far above what it had originally been. Apparently the workers involved were responding to something



other than the intended experimental treatment. It finally was evident that they thrived on attention.

In view of the above, some have concluded that the experimental method cannot be used successfully in studying effects of incentives. Yet this sort of danger also is present in the physical and biological sciences, and the methods used by physical and biological scientists to minimize this danger can be adopted by social scientists.

The difficulty underlying what social scientists refer to as the Hawthorne Effect is that treatments applied by experimenters may have a richness which is not fully captured by the specification of experimental variables. In the case of the Hawthorne experiments, the experimenters systematically and consciously altered room color—but inadvertently altered the attention paid to the experimental units receiving the intended treatment. As long as changes in room color occurred along with changes in attention, the incorrect association of room color with response was a likely error. In fact, if this one-to-one correspondence is maintained, the resulting error in association probably will not be discovered. Nor will there be any consequences. However, serious problems occur when the measured treatment variables and the unmeasured treatment variables are tightly linked during experimentation—but are not linked, or are linked in quite a different way, during application.

In the context of negative income tax experimentation, various negative income taxes would be applied to groups of experimental subjects. The fear is that the response of the experimental subjects might be due to attention or some other aspect of the experimental treatment that would not be duplicated if a real negative income tax law were enacted.

The first and most obvious step in minimizing the danger behind the Hawthorne Effect is the use of treatments which are as similar as possible to actions that might actually be taken by policy makers. In this way the same associations between measured and unmeasured treatment variables will occur during both experimentation and application. The experimenter may decide why something works for the wrong reasons, but at least it will probably work for the same wrong reasons during application by policy makers. In the case of negative income tax experimentation, this means that a serious effort should be made to avoid giving excessive attention to experimental tax units.

A second major line of defense is the thorough use of control groups. Three types of control groups come immediately to mind. The first is obtained by randomly allocating experimental subjects between treatment groups and a control group. An effort is then made to treat both the control group and the treatment groups in exactly the same way, except for the treatments of interest. For example, if attention is not considered part of the treatment, an effort must be made to give mem-

bers of the control group as much attention as members of the treatment groups. This will only be feasible, of course, if the experimenter at least recognizes the possibility that attention might play a significant role in influencing behavior.

Two additional types of control groups can be obtained by observation of the treatment groups both prior to treatment and after treatment has been stopped. In effect it was really by the use of such self-control groups that the Hawthorne Effect was discovered. Intended treatment stopped but the observed effect continued. This made it possible to avoid incorrectly attributing changes in productivity to changes in room color. Thus instead of regarding discovery of the Hawthorne Effect as pointing up a weakness of the experimental approach it might even be possible to regard it as showing how effective a well-designed experimental approach could be.

The third major line of defense is the use of experimentation in depth. Treatments are systematically regarded as involving many dimensions. By controlling more aspects of administered treatments the experimenter reduces the possibility that some unconsidered aspect of a treatment is what is really important. Depth of knowledge is sought and, with achievement of depth, less room is left for unpleasant surprises.

### III. *Policy Variables and Choice of Primary Experimental Variables*

Choice of experimental variables lies at the heart of any experimental strategy. Two different possibilities suggest themselves. The most obvious choice to the social scientist grounded in the lore and spirit of the dominant physical and biological sciences, is to select, develop, and use experimental variables which appear in well-developed hypotheses. No one knows for certain how new hypotheses suggest themselves, but the search is for knowledge and the scientist follows wherever the trail leads.

A second possibility, however, which may suggest itself more forcibly to economists is to use as experimental variables those variables which policy makers can and are willing to control, or might reasonably learn to control. The objective, in this case, may not be knowledge so much as the more utilitarian objective of learning something that would be useful in developing and applying social policies.

Given unlimited resources and time, no conflict would exist between the above two strategies. The difficulty, however, is that in our present state of ignorance the number of interesting hypotheses which might be investigated in the social science area comes close to being infinite, while the resources available for investigating them are not. The world could wait for the discoveries of the physical and biological sciences, but once having acquired our present powers in these areas it is not certain that

mankind can afford to wait indefinitely for the knowledge needed to bring our social activities under some reasonable control.

No doubt the tools available to governmental policy makers can, and should, be enlarged. Yet really new policy tools of major significance suggest themselves but rarely, and are difficult to incorporate and master successfully. In addition, a wide and varied collection of policy tools are available already. We should attach great importance to finding which of these tools are suitable for use, and how they may be effectively used singly and in combination to achieve what needs to be achieved.

Types of variables which suggest themselves as experimental variables, by virtue of the fact that they might to some extent be controlled by governmental policy makers, include the following: payments of money and/or economic goods and services; availability and terms of employment; tax rates and schedules; availability and terms of loans; prices at which goods and services are available; rate of return offered on investments; and availability of information. For negative income tax experimentation, the experimental variables to be used would be payments of money combined with application of simulated tax rates and schedules.

It is obvious, of course, that the range of possibilities open to the experimenter is subject to some restrictions that don't apply to the government policy maker. Government can require compliance with a tax law, whereas the experimenter must obtain the voluntary cooperation of experimental units. Hence, determination of the effect of rewards seems more feasible than similar experimentation with penalties and/or prohibitions. However, experimentation of the latter sort might be feasible in cases where a penalty or prohibition is already in use by government. The experimentalist might investigate the effect of the penalty or prohibition by experimenting with its removal or reduction.

Another approach to investigating the effect of a basically unpleasant variable, such as a tax rate, might be to use two or more experimental variables in combination. For instance, various tax rates could be combined with payment of a specified sum. In this way the combination might be made attractive to prospective experimental units. This approach would be ideal for negative income tax experimentation since both types of treatment are aspects of a single law tax. Thus, in negative income tax experimentation, the experimenter is seeking to determine the separate effects of both the base support level and the marginal tax rate. However, if the objective were to learn the effects of marginal tax rates at higher levels of income, it might still be necessary to combine a variety of marginal tax rates with each of a variety of lump sum transfers in order to obtain any experimental units.

#### IV. *Choosing Experimental Units*

A prime consideration with respect to many of the policy variables that can be controlled by government is the resulting ratio of benefits to costs. This means that studies considering the effects of policy variables should seek not only to measure benefits in relation to costs, but also to uncover ways in which the ratio of benefits to costs could be increased. In this connection one objective of incentive experimentation should be the determination of how response depends upon the type of unit receiving the incentive, as well as on the manner in which the incentive is applied.

Evidence suggests that individuals respond most strongly to incentives and disincentives which, by their nature, can only be given by other individuals. Thus the possibility arises that the most effective way for governmental policy makers to apply economic incentives may be to provide group rewards for individual behavior. By so doing, groups may be motivated to provide their members with attentions individuals desire but cannot buy—i.e. respect, appreciation, attention, concern, love and affection.

Behavioral units which should be considered as possible candidates for experimental study include the following: individuals, families, household units and other spending units; work oriented groups, neighborhood groups, villages, towns and cities and social, religious, and other such associational groups. In negative income tax experimentation, the experimental units presumably would be either individual adults or married couples that might be tax units if a negative income tax law were to be enacted.

#### V. *Multiple Regression, Analysis of Variance, and Use of Parameters*

The following considerations are of a general nature but have been presented in a specific context for expositional convenience. Earned income during time period  $t$  of tax unit  $i$ ,  $Y_{ti}$ , may be thought of as some unknown function of  $t$  and  $i$ . This may be expressed as follows:

$$Y_{ti} = F(t, i).$$

Given an interest in determining the influence on earned income of a negative income tax, as characterized by two tax law parameters,  $\alpha$  and  $\beta$ , experimentation might be used in estimating and evaluating the following specification of the above equation.

$$Y_{ti} = F_1(\alpha_{ti}, \beta_{ti}, Y_{t-1,i}) + F_2(t) + U_{ti}.$$

Let us suppose the experimental use of  $\alpha$  and  $\beta$  will start with  $t=1$  and that prior to this both  $\alpha$  and  $\beta$  are equal to zero. Let us also suppose



that a sample of experimental units is selected for observation during  $t=0$  and that selected combinations of  $\alpha$  and  $\beta$  are assigned to these experimental units by a random process at the end of  $t=0$ . Particular interest should center on the determination of the influence of  $\alpha$  and  $\beta$  on earned income, but failure to utilize the predictive value of  $Y_{t-1,i}$  would result in a sizeable and unnecessary increase in the error variance. For any given sample size the precision with which the influence of  $\alpha_{it}$  and  $\beta_{it}$  on  $Y_{it}$  could be determined would be reduced.

Unless we wish to merge experimental evidence from different time periods,  $F_2(t)$  will have the same value for all experimental units and can be treated as a constant. Even if we do wish to merge evidence from different time periods,  $F_2(t)$  does not pose much of a problem since it can be represented perfectly using a single parameter per time period.

The real question arises when a decision is made about the form of  $F_1(\alpha_{it}, \beta_{it}, Y_{t-1,i})$ . Given an unlimited number of observations, assumptions or approximations about the form of  $F_1$  could be avoided by replicating each relevant combination of  $\alpha$ ,  $\beta$ , and  $Y$  until achievement of the desired accuracy in the determination of  $F_1$ . Having used a factorial experimental design, the resulting data could be subject to a three-way variance analysis with  $Y_{it}$  as the dependent variable. Each combination of  $\alpha$ ,  $\beta$ , and  $Y$  would lead to the estimation of one response parameter. If ten values of  $\alpha$ ,  $\beta$ , and  $Y$  were of interest, then 1000 parameters would be required. The number of experimental units required would be some multiple of 1000.

An alternative approach to the estimation of  $F_1(\alpha_{it}, \beta_{it}, Y_{t-1,i})$ —and one which is far more attractive given high experimental unit costs and several continuous variables—is to approximate  $F_1$  by means of either a linear or a quadratic function of  $\alpha$ ,  $\beta$ , and  $Y$ . The linear approximation would take only three parameters while the quadratic would take a maximum of nine. How particular negative income tax laws could be represented by the values of two or three parameters is described in a subsection of Section VI of this paper.

A parsimonious use of parameters is important because it becomes impossible to estimate parameters with precision as their number approaches the number of experimental units. In fact, several hundred or even thousand experimental units per parameter estimated may be required in some cases to achieve acceptable levels of precision. This does not mean that the usual analyses of variance approach should be discarded. However, a microanalytic multiple regression approach is almost certainly going to be attractive, and should be provided for. In such an approach, primary interest will center on the accuracy with which the influence of  $\alpha$  and  $\beta$  can be determined; not on the accuracy with which individual  $Y_{it}$  can be predicted.

The policy maker needs to know the extent, if any, to which tax units will reduce their earned incomes in response to a tax law. He does not need to know how other individual and environmental factors influence earned income. Such other variables are only to be included in the analysis in so far as they significantly reduce error variance, and thereby improve the precision with which the influence of the tax parameters  $\alpha$  and  $\beta$  can be estimated. It is on this basis that the use of earned income, prior to introduction of an experimental tax treatment, is justified. The use of income of control individuals or groups also might be justified in this manner.

### VI. *Relevance*

The steps from field experimentation to policy applications appear more certain than similar steps from nonexperimental research. Still experience indicates that there are pitfalls. The following subsections indicate ways in which the relevance of experimental findings may be increased.

#### *Selection of Experimental and Observational Variables*

The obvious point to be made here is that selection of experimental and observational variables should take into account what it is that policy makers could control, and what it is that they want to achieve control over. The experimental variables then should include variables which policy makers can control, and the observational variables should include those which policy makers wish to control. The experimenter may, of course, hold constant or vary additional variables in order to eliminate unwanted sources of variation, and to assist in clarifying the role of the primary experimental variables. The experimenter also may wish to observe other variables besides those which interest policy makers. One purpose of doing this is to guard against the possibility of unsuspected and deleterious side effects.

#### *Selection of Experimental Units*

The concern here is not so much with the type of experimental unit as it is with the choice of a sample of experimental units to be selected from a population of individuals, or group of individuals, of the same type. The issues are similar to those involved in the choice of respondents in sample surveys.

If all members of the population of units sampled respond in identically the same way to treatments, except for purely random variation from trial to trial, then many methods of selecting experimental units will be satisfactory. However, if members of the population respond in systematically different ways, then the results obtained may depend

critically on the choice of experimental units. In this situation, relevance of experimental findings can be enhanced by selecting a set of experimental units which are as representative as possible of the population with which policy makers must deal.

If experimentation is to shed light on what would happen if a specific negative income tax law were enacted, there is some point to using as experimental units a probability sample of tax units drawn from the entire U.S. population. Since there is no way of sampling future populations, it is never possible to sample exactly the populations that will be affected by future policy decisions. Nevertheless, it is clear that the relevance of experimental findings can be greatly increased by careful selection of experimental units. Randomization in the assignment of treatments to experimental subjects can guard against biases in making inferences about the responses of experimental units. It cannot guard, however, against errors that might follow from applying results obtained with one type of individual, or group, to individuals or groups of a drastically different type.

Part of the problem of conducting relevant experiments is to achieve an adequate correspondence between experimental treatments and potential negative income tax laws. One point of difficulty is that under actual tax laws individual tax payers are able to remain fairly anonymous and to keep their tax payments a matter of personal rather than public knowledge. Can these features of real tax laws be duplicated in an experimental study? Use of a geographically dispersed sample, such as could be achieved if experimental subjects were themselves a probability sample of the relevant segment of the entire U.S. population, would help a great deal on this score as well as yielding a representative group of experimental units. Maintaining the anonymous position of experimental units also would be facilitated if no information were released even about the city and state of residence of experimental subjects.

### *Selection of Environment for Experiments*

Laboratory experimentation is attractive because of the possibilities it seems to offer of achieving control over the experimental variables. Nevertheless, in the case of policy oriented incentive experimentation, it seems clear that primary reliance should be placed on field experimentation. The primary drawback of placing much reliance on laboratory experimentation is that the conditions under which research results need to be applied cannot be satisfactorily duplicated in the laboratory. Many variables besides potential policy variables influence behavior. In fact, the influence of those potential policy variables of concern may be minor relative to the effect of other variables which vary but little

in a distributional sense from year to year for the population as a whole. Nevertheless the levels of these other variables in a laboratory setting might be very different from what they are in real life. If the effects of these other variables and the experimental variables of central interest are additive, this would not be disastrous. However, the assumption of additivity, while frequently satisfactory over relatively small ranges of variation, is often unsatisfactory over large ranges. The mere fact that the values of these other variables might be held constant in the laboratory would be of little help, since the basic difficulty is that they would be held constant at the wrong levels.

In the case of variables which are singled out for explicit consideration, it might be possible to guard against falsely assuming additivity. However, in the present state of our knowledge, many variables of importance are bound to be unknown. The role of these variables can not be taken into account in any adequate way. Hence, the advisability of applying laboratory results directly in making policy decisions is questionable. To guard against such surprises it is important for experimentation to be carried out in as realistic settings as possible, and with samples of experimental units which are representative of the populations with which policy makers must deal.

### *Parameterization and Generality of Results*

In the original negative income tax experimentation proposed by the United Planning Organization, each tax law considered was treated as an essentially different treatment, rather than as a composite treatment involving a different combination of levels of parameters used to specify the essential features of a tax law. Unfortunately results obtained in this manner could not be easily generalized. If it were true that a specific negative income tax law could be selected as better than all alternatives, then the proposal might be justified in the same way that building a pilot plant might be. A last chance would be provided to see if the relevant theory holds. And at the same time, unforeseen operating problems could be identified and overcome. In this case, however, the scale and coverage of the suggested experiments would provide for only a tiny pilot experience. Moreover the theory which is available is far from adequate to guide us to the best one, or even to the best three or four, negative income tax possibilities. Instead, what we need is a more fundamental understanding about how such variables as the income of tax units are related to the significant characteristics or parameters of any negative income tax law.

Parameterization of negative income tax laws could be carried out in a variety of ways, but the following approach strikes us as the best. Its main virtue, aside from the fact that it is operational, is that the param-

eters singled out are expected to have independent, or almost independent, roles in respect to behavior. This orthogonality of role may not be an overriding requirement, but it will facilitate specifying a maximum amount of relevant information about a tax law with a given number of parameters.

For a given type of tax unit with a given initial income, possibly the most significant aspect, as far as income earning effects are concerned, of any linear or nonlinear negative income tax law would be the dollar transfer which that tax unit would receive in the absence of any adjustment of pretax income. Let this amount be the first parameter characterizing any negative income tax law as it applies to this tax unit. Possibly the second most significant aspect of a negative income tax law for any specific tax unit would be the marginal tax rate that would apply to changes in income earned by the unit. Let this marginal tax rate be the second parameter. In practice the above two parameters would appear adequate to describe the relevant features of all linear, and many nonlinear, tax laws for any specific tax unit. In the case of nonlinear tax laws they would provide a linear approximation of any law in the region which is most relevant to the specific tax unit. If, however, a third parameter seemed desirable, it might be the base support the tax unit would receive if it had no other income minus the base support it would receive under a linear tax law specified by the first two parameters. The effect of negative income tax on family composition and child bearing probably would depend on how the tax law provided for dependents. An additional one or two parameters might well be needed to capture this aspect of a tax law.

In the next section we discuss how a microanalytic regression approach would facilitate generalizing results obtained by study of one population to those to be expected for other populations. Suffice it to say that the microanalytic regression approach would likewise facilitate generalization of results to any tax law which could be locally approximated for individual tax units by use of the two or three experimental parameters

### *Microanalytic Regression and Generality of Results*

A second weakness of the proposed experimentation, or at least of the method of analysis anticipated in the original proposal of the United Planning Organization, is that primary emphasis is placed on the determination of group means and on the accuracy with which such group means could be determined. This emphasis might be in order if each experimental group was in fact a probability sample from the same population to which any future negative income tax law would be applied. Since, however, future populations subject to any negative income tax

legislation may differ in vital respects from the population to be sampled in the proposed experimentation, it does not appear that primary significance should be attached to the means of the experimental groups. Nor is it evident how generalization from the responses of these groups to the responses of other groups would be achieved.

Use of a microanalytic regression approach would facilitate generalization from the responses of experimental units to the responses of groups having a composition which differs in some respects from the group from which experimental units are drawn. With this type of analysis the dependent variables in the regression equations should be individual, or individual tax unit, response variables. The predictor variables in such regression equations should include the values of the tax parameters which are being treated as experimental variables, plus individual tax unit, and environmental characteristics which may play important roles in determining the values of the dependent variables.

Use of a regression approach based on data from micro units would permit estimating relations which were intended to apply to micro units, and, by doing so, facilitate generalizing from results based on particular samples to the results which might be expected for other populations and other specific negative income tax laws. Such multiple regression equations, once estimated, could be used to predict the response of each member of a new population to a specific tax law. Appropriate values for the tax law parameters and appropriate values for those variables needed to describe the members' individual and environmental characteristics would simply be plugged into the regression equations. Having predicted the response of each member of a new population, or at least of a random sample of the members of a new population, predictions about the aggregative implications of the new tax could be obtained by summation of the micro predictions.

### *Relevance and Duration of Experiment*

A real negative income tax law might go on forever. An experiment must terminate. Does this introduce an inescapable difference between any experimental situation and the situation that would be associated with a real negative income tax law?

One way of minimizing this problem is to conduct experiments which do extend over as long as from three to five years. This would seem to provide as much certainty about the future as is provided by congressional action.

A second way to deal with this problem would be to let the length of the experimental treatment also be an experimental variable. If essentially the same responses or lack of responses result from experimen-

tal treatments extending over three, four, and five years, then the fact that a real negative income tax might go on forever would not seem to matter. If responses were found to depend upon the length of experimental treatment, then some basis for making the necessary extrapolations also would have been obtained.

### VII. *Economizing Possibilities*

Costs are the single most important barrier to a program of planned incentive experimentation. Incentives applied experimentally must be large enough to be noticed, and to be in the range of potential application. Moreover, since all experimental units must be willing subjects, it follows that each experimental unit must come out ahead. This means that the possibility of minimizing costs by use of penalties as well as rewards is limited. This section mentions several ways, however, in which experimental costs might be held down.

#### *Sequential Experimentation*

The basic idea behind sequential experimentation is to start with a small number of experimental units, and gradually increase the number of replications of the experimental treatments until the desired precision of results is achieved. This sort of experimentation permits postponing a final decision about sample size until initial experimentation has generated estimates of error variances and magnitudes of effects. Otherwise the experimenter must pick a sample size which will be large enough under the worst possible assumptions. This leads frequently to the use of samples which are larger than needed. Or else, the sample size may be inadequate, and the whole experiment may fail.

Another advantage of starting each experiment with a small number of experimental units is that gross errors in technique or experimental design may be discovered before the success of an entire costly experiment is jeopardized.

#### *Joint Use of Control Groups*

A group of experimental units which is not exposed to experimental treatments could, of course, serve equally well as a control group for judging the effects of experimental treatments performed on any number of other experimental units. Thus, if several experiments were performed simultaneously, some economy might be achieved by using a single control group for the whole set of experiments.

#### *Joint Use of Treatment Groups*

In many cases it seems reasonable, at least as a first approximation, to assume that the effects of two or more quite distinct experimental variables are additive. Use of an experimental design which achieves

orthogonality between the different experimental variables permits the use of the same experimental units as subjects for each of several experiments.

### *Joint Use of Experimental Treatments*

Sharing the costs of a given set of experiments among several customers is another way of lessening the costs problem. In the case of negative income tax experimentation, for instance, there are some who are interested in work related responses, others who want expenditure information, and still others who are interested in the effects of negative income taxes on family formation and fertility. By collecting information on several observational variables, all of the above potential customers could obtain knowledge which they desire from the same basic set of experiments.

### *Joint Use of Specialists, Field Staff, and Facilities*

An individual experiment may require the services of experts in sample design, sample selection, data collection, statistical analysis, computer use, etc. But any one experiment is likely to use only a fraction of the time of several such specialists. Clearly, economies of scale are possible. In particular, since sample survey organizations already require an expert staff, economies might be achieved by combining a program of incentive experimentation with a sample survey program. This might even permit the use of sample survey respondents as a control group for a wide variety of experimental studies.

### *Problem Selection and Specification*

In addition to the above possibilities for economizing, there may be many additional ones having to do with problem selection and specification. For instance, if policy makers are interested in knowing whether or not some policy variable has an appreciable effect, the experimenter can focus on the detection of linear effects. In general this will be less expensive than determination of a nonlinear response surface.

## VIII. *Recommendations*

In building knowledge and securing experimental evidence of vital concern to policy makers the full force of the scientific, experimental method should be brought to bear. The supply of pressing, unanswered social questions is enormous. How can any given experiment be expected to more than nibble at the mountain of our ignorance? Yet the nibbles can be enlarged, given some coordination, and stepped up in frequency. This surely is what has resulted in the marvelous flowering we are enjoying of the physical and biological sciences.

Incentive, disincentive, and motivational experimentation, of course,



are not the only research areas of crying importance to policy makers. But they are perhaps the most important. In any case, it is clear that policy oriented incentive experimentation should be undertaken in a systematic way, on an operationally viable scale, and *on a long-run basis*.

A long-run approach to social experimentation, however, needs—and in fact, demands—long-run financing for its assured success. This is necessary for wise planning. And it is essential to building up, and keeping together, an effective research team. A commitment of at least one or two million dollars per year under an arrangement providing for a three- to five-year moving horizon, with the horizon to be extended after each annual review, is needed for each major center of field experimentation established in the United States.

Some economies and increased effectiveness might be achieved by developing experimental, field research programs in close association with major survey research organizations. At no extra cost, sample survey respondents might in this way be made available for use as members of control groups. Also specialists and special facilities needed by sample survey organizations could be used to meet the needs of field experimentation. Regardless of the specific arrangements though, ways should be found to ensure that those major centers of experimentation and surveying inaugurated will be of use to social science researchers across our nation. It is time we set up some Mt. Palomars for the social sciences!

## DATA AGGREGATION AND INFORMATION LOSS

By GUY H. ORCUTT, HAROLD W. WATTS, AND JOHN B. EDWARDS\*

In view of the fact that the federal government collects an enormous amount of information from or about households and firms, it is surprising how frequently the researcher discovers that the only behavioral units for which suitably matched data are available are national aggregates—the whole household sector, for example. Thus, matching time series of total consumption and income are simply not available for individual or groups of individual households classified by location, age of head, assets, race or any other characteristic.

To the researcher or policy maker interested in the economic performance and development of a small area or region, the unavailability of suitable time series in the area of specific interest is an obvious handicap. For researchers and policy makers interested in the prediction and control of national aggregates, however, the handicap is not so obvious, and, in consequence, more serious.

Aggregation of data for purposes of research and analysis may upon occasion be very much in order. But aggregation before analysis discards information, and the researcher should have something to say about the tolerability of such loss. The purpose of this study is to demonstrate that the loss of effective estimation and testing power, incurred through aggregation carried all the way up to the national level, can be extremely great.

The procedure adopted is as follows. In Section I a microanalytic model is set forth which is to serve as a hypothetical real economy. Computer simulation of this "Economy" is used to generate unaggregated data for selected intervals of time, and calculations for ordinary least-squares regression analysis are carried out on the basis of the unaggregated data and on the basis of the same data aggregated over behavioral components. In Section II the design of the simulation experiments is set forth. The discussion of the results is in Section III. The final section is devoted to conclusions.<sup>1</sup>

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<sup>1</sup> Other studies dealing with various implications of data aggregation include: Cramer [1], Dunn [2], Feige and Watts [3], Grunfeld and Griliches [4], Kaysen [5], Nerlove [6], Orcutt [7], 8], Orcutt and Watts [9], Prais and Aitchison [10], Ruggles [11], and Theil [12].

### *I. Model Formulation*

#### *Objectives*

In developing a model to serve as a hypothetical version of a real economy, one has perforce to rely heavily on personal judgments about which features of economic systems might be critical. To mitigate this as far as possible, a flexible model has been developed which can be conveniently altered in those respects believed to be significant. As more realistic microanalytic specifications of the economy become available, they can be used in similar studies. The true nature of our economy may not be known, but it seems reasonable to seek procedures for studying the economy which would work satisfactorily if the world is like our models of it. At least we ought to be able to estimate the significant features of our models from the data they have generated.

The loss due to aggregation will depend on the underlying nature of the real world, the type of aggregation carried out, the relation of the equation or equations being studied to the real world, and the choice of statistical method for estimation and testing. In any actual investigation the type of aggregation used and the equation or equations being estimated or tested would be known. The choice of statistical methods for estimation and testing is not a major issue at this point since it is hoped that the analysis of aggregation effects may be carried out for any method of interest. The real problem lies in trying to specify those features of the real world which are significant for this study.

In real economies macro- and microcomponents are subjected to stimuli which vary more or less continuously. The responses of these components presumably lag the stimuli by at least some small interval of time and may themselves be distributed over time. The stimuli which components receive are likely to be autocorrelated time series and stem in part from the behavior of other components of the economy. Since much of the behavior of most components is a response to previously received stimuli, it is clear that the economy is a system of interacting behavioral components. Thus, feedbacks and autocorrelated time series are two prominent features that should be incorporated into the model. This is especially important, since it is known that these features have an important bearing on the effectiveness of estimation and testing procedures.

#### *Equation System*

The following equations single out the critical interdependencies of a simple economy with  $n$  spending units and a government. The government is thought of as the policy maker. It levies taxes on the income of spending units and it buys goods and services through the market. The  $n$  spending units are the microcomponents of this model and might be

thought of as households, firms, and other types of behavioral components. No product distinctions are explicitly recognized and all goods or products including labor are sold and bought with money through a single market. The market thus serves as a device to link the behavioral components and to close the circulation of money. The total income of spending units before taxes is the sum of expenditures of the  $n$  spending units and those of the government. This total is distributed among spending units on the basis of their past share, individual characteristics, and a random term. Expenditure of a spending unit is related to both its lagged disposable income and its net financial assets at the end of the previous period.

### *Microanalytic Equations*

- (1)  $E_{it} = \delta + \alpha Y_{i,t-1} + \beta M_{i,t-1} + U_{it}$
- (2)  $M_{it} = M_{i,t-1} + Y_{it} - E_{it}$
- (3)  $Y_{it} = (1 - R_t)(E_t + G_t)(I_{it}/I_t)$
- (4)  $I_{it} = a_0 + a_1 I_{i,t-1} + V_{it}$

### *Implicit Macroanalytic Equations for the Nongovernment Sector*

- (5)  $E_t = n\delta + \alpha Y_{t-1} + \beta M_{t-1} + U_t$
- (6)  $M_t = M_{t-1} + Y_t - E_t$
- (7)  $Y_t = (1 - R_t)(E_t + G_t)$

where for the  $i$ th unit at time  $t$

$E_{it}$  = expenditures

$M_{it}$  = net financial assets

$Y_{it}$  = disposable income

$I_{it}$  = index for distributing income

$U_{it}$  = stochastic term for expenditures

$V_{it}$  = stochastic term for income distribution

The corresponding letters without the subscript  $i$  indicate summation over the  $n$  spending units.

The variables relating to government activities at time  $t$  are:

$G_t$  = expenditures

$R_t$  = tax rate on aggregate income of the spending units

The parameters are:

$\delta$  = constant term in micro-expenditure function

$\alpha$  = propensity to spend disposable income

$\beta$  = propensity to spend financial assets

$a_0, a_1$  = parameters of income distribution function

The model is quite eclectic as it stands, incorporating two strands of contemporary income theory by way of the parameters,  $\alpha$  and  $\beta$ . By appropriate choice of parameters the model can be: (1) an expenditure-multiplier model ( $\beta=0$ ); (2) a quantity theory model ( $\alpha=0$ ); or (3) a stock-flow adjustment model with quantity theory overtones.

### *Choice of Parameters and Initial Conditions*

In order to run computer experiments, the model required specific formulation. We based our choice of parameters on empirical findings using U.S. economic data. An ordinary least squares regression of total private expenditures on lagged disposable income and lagged private claims of the public and rest-of-world sections achieved a multiple correlation (squared) of 0.9951 for the combined 1930–1940 and 1946–1963 periods. The addition of an accelerator term had essentially no effect. Alternative autoregressive transformations were also tried; but the fit, in terms of the residual variance, was not importantly affected. The estimates of  $\alpha$  and  $\beta$ , however, were sharply affected by the choice of autoregressive transformation. They range from  $\alpha=0.96$  and  $\beta=0.13$  for the untransformed data, to  $\alpha=0.44$  and  $\beta=1.3$  for the first differences (autoregressive parameter=1). These highly interrelated estimates are both the consequence of the closely correlated movements of disposable income and “money” and an eloquent example of the poverty of useful information found in aggregate series. These data do not permit one to distinguish the effects of two influences as conceptually distinct as a stock and a flow!

The fit of this particular model is not of primary importance other than in giving some assurance that the “economy” constructed to generate our data is at least superficially consistent with data generated by an actual economy. The parameter values chosen for the experiments described below are:

$$\delta = 0$$

$$\alpha = 0.9$$

$$\beta = 0.2$$

These values lie comfortably within the region which achieves a high correlation with the time series data.

Notice that the model could have been specified with a different  $\alpha$  and  $\beta$  for each microcomponent. This would certainly add a greater degree of realism, and we hope to explore this case in subsequent studies. Another note of realism could have been added by introducing a mechanism to produce a long-term trend in all variables. This would have induced more realistic correlations at the macro level and should be considered in future studies.

In selecting the number of spending units, considerations of computer

time were of importance. Since we desired a large number of replications of the experiments in order to determine reasonably well the means and variances of the distributions of interest, a large number of spending units would lengthen the computations considerably. Furthermore, there does not appear to be any reason why sufficient information regarding the consequences of aggregation cannot be obtained from a modest-sized economic model. We selected sixteen as the number of micro spending units.

Arbitrary equilibrium levels for the variables were determined in order to "start up" the model. Assuming a constant tax rate,  $P$ , equal to 0.2 and a fixed public expenditure,  $G$ , equal to 40, the aggregate equilibrium values of the other variables are:

$$\bar{Y} = 160$$

$$\bar{M} = 80$$

$$\bar{E} = 160$$

The total gross income is, of course,  $\bar{E} + \bar{G}$  or 200, of which the government collects two-tenths or 40, thus balancing its budget.

## II. Design of Experiments

We now turn to the design of computer experiments for studying the effects of data aggregation on least-squares estimates of equation parameters. The true parameter values for the data-generating mechanism are known. Therefore, repeated samples of the least-squares estimates of these parameters allow direct computation of the first and second moments for the estimates, and hence the bias and mean square error. The basic model for each of the 16 micro-components is:

$$E_{it} = 0.9Y_{i,t-1} + 0.2M_{i,t-1} + U_{it}$$

$$Y_{it} = (1 - R_i)(E_i + G_i)(I_{it}/I_i)$$

$$M_{it} = M_{i,t-1} + Y_{it} - E_{it}$$

$$I_{it} = 1/16 + V_{it}$$

$$U_{it} \sim N(0, 0.25) \text{ independently distributed over } i \text{ and } t$$

$$V_{it} \sim N(0, 0.0001) \text{ independently distributed over } i \text{ and } t$$

Starting with 10 units of disposable income and 5 units of assets for each component, the economy is simulated for a "history" of: (a) 20 consecutive time periods or years, and (b) starting with the same initial conditions including the same initial values for the random variables, 80 consecutive years. These observations provide the microdata covering the 16 units. These same observations are then aggregated into four groups of four units each for semiaggregated estimation; and finally into a single group for fully aggregated estimation. The sample sizes for

these three modes were thus 320, 80, and 20 for the 20 years per history case and 1280, 320, and 80 for the 80 years per history case. This design facilitates a comparison of the merits of (1) more observations via disaggregation and (2) additional points at the same aggregation level. Notice that the 20 years per history case has the same number of observations per estimate at the micro- and semiaggregated levels as the 80 years per history case has at the semi- and fully aggregated levels respectively.

The task is to estimate the parameters of the following equation including the variance of the stochastic residual.

$$E_t = \delta + \alpha Y_{t-1} + \beta M_{t-1} + U_t$$

Estimation was done by ordinary least-squares at each of the three levels of aggregation. The means and variances of the parameter estimates were computed by repeated sampling. For the 20 years per history case, 400 samples were taken. For the 80 years per history case only 100 samples were taken in order to provide comparability in the precision to which the moments were determined.

The estimated standard errors of the parameters are computed from the usual formulas relating to least-squares regressions and then averaged. Also, the average  $R^2$  values are tabulated.

In order to remove correlation between samples due to overlapping, a separate history was run prior to the first and between each of the subsequent histories. For example in the 20 years per history case, 800 consecutive histories were run, samples being taken from even-numbered histories.

Four separate variations or experiments were run—

#### *Variation 1: Primary Model*

The primary model as described above

$$R_t = 0.2 \text{ for all time}$$

$$G_t = 40 \text{ for all time}$$

#### *Variation 2: Autocorrelated Income Shares*

Replace the parameters of the income distribution equation (4) as follows:

$$a_0 = 0.01875$$

$$a_1 = .7$$

$$V_{it} \sim N(0.000051)$$

All other variables are as in the Primary Model. Note that the mean and variance of  $I_{it}$  remain the same as for the Primary model.

### *Variation 3: Compensatory Fiscal Policy*

Assume the government can predict private spending without bias and with an error of approximately 1 per cent. The government then aims to close half of the predicted "gap" between private expenditure and the equilibrium value of 160. Since 1 per cent of 160 is 1.6, this would be the standard deviation for a normal error if it were less than 1 per cent about two-thirds of the time. The variance would be  $(1.6)^2 = 2.56$ . We therefore introduce the following compensatory fiscal policy equation

$$G_t = 40 + .5(160 - E_t + \eta_t) \\ \eta_t \sim N(0, 2.56)$$

or equivalently:

$$G_t = 120 - .5E_t + \epsilon_t \\ \epsilon_t \sim N(0, 0.64)$$

### *Variation 4: Balanced Budget Policy*

Assume, again, approximately a 1 per cent error in estimates of revenue from taxation at the equilibrium level of the economy. The estimated revenue at equilibrium is 40, and if 1 per cent of this is the standard deviation of the error then its variance is 0.16. Therefore, in an attempt to balance the budget, the government policy would be:

$$R_t(E_t + G_t) = G_t + V_t \\ V_t \sim N(0, 0.16)$$

or, equivalently at equilibrium:

$$R_t = \frac{G_t}{E_t + G_t} + \lambda_t \\ \lambda_t \sim N(0, 4 \times 10^{-6})$$

To sum up, the experiments are divided into two cases: 20 years per history, and 80 years per history. There are 400 replications and 100 replications respectively for each case. The replications provide Monte Carlo sampling distributions for the parameter estimates and other statistics of the regression equation. Sampling distributions are produced for estimations based on three levels of aggregation. All of the above is done under four variations of the equation system.<sup>2</sup>

<sup>2</sup> The program for these Monte Carlo experiments were written in Fortran IV and run on the IBM 7094 Computer at Harvard University. The total time to develop and run the programs consumed about two hours of computer time. The normally distributed random numbers were generated by the library subroutine at Harvard entitled RANDOM.



### III. Results

The main results of the simulation experiments are shown in Table 1. The means and standard deviations of each statistic are given for each of the four variations. Where applicable, the average estimated standard error is shown. The constant term  $\delta$  is on a per capita basis (see equation 5). The stochastic error variance  $\sigma_\mu^2$  is maintained at 0.25 at the three levels by dividing all variables by 2 before estimating at the semi-aggregated level, and again by 2 before estimating at the fully aggregated level.

Table 1 is divided into two cases (20-year and 80-year histories) which are in turn subdivided into three columns corresponding to statistics derived from micro-, semi-, and fully aggregated data. We report the mean and standard deviation of each statistic of interest. The standard deviation of a mean derived from 20-year histories will be one-twentieth of the standard deviation of the corresponding statistic since there were 400 replications. The standard deviation of a mean derived from an 80-year history will be one-tenth of the standard deviation of the corresponding statistic since there were 100 replications. For those statistics which have a computable standard error of estimate from the least-squares regression model, we show the mean value of this.

The following discussion attempts to bring out the more important implications of the results.

#### *General Remarks*

*Primary Model (Variation 1).* The results for the primary model are relatively uncomplicated but they do underscore a number of useful lessons. The same basic model holds at all levels of aggregation. Considering the recursive equation for private expenditures, note that the disturbance is an independently and identically distributed variable at each time and for each microunit, it is normally distributed, and it has no contemporaneous correlation with the predetermined variables. Hence, all the requirements for regarding single equation-least squares as a maximum likelihood procedure are met at each level of aggregation. By this argument the estimates are consistent and efficient.

As is well known, the maximum likelihood estimates obtained from small samples may be biased. Bias may, as in this case, come about because there is not complete independence between the independent variables and the disturbance. The variables  $M$  and  $Y$  will reflect, and hence be correlated with, past values of the disturbance. In Table 1 it appears that the estimates of  $\alpha$  and  $\beta$  in the appropriately specified equation tend to have slight biases at the micro-level and much larger ones at higher levels of aggregation.

TABLE 1—MEANS, STANDARD DEVIATIONS AND AVERAGE ESTIMATED STANDARD ERRORS OF THE EXPERIMENTAL SAMPLING DISTRIBUTIONS\*

Model Variation	Statistic	20-Year Histories			80-Year Histories		
		Micro	Semi-Aggregated	Aggregated	Micro	Semi-Aggregated	Aggregated
1. Primary	$\delta$	.045	.155	-.907	.015	.062	-.219
	(0.0) s	.241	.515	3.527	.126	.297	1.256
	a	.243	.513	3.025	.120	.245	1.145
	$\alpha$	.891	.867	.794	.897	.889	.893
	(0.9) s	.038	.079	.256	.019	.046	.123
	a	.037	.077	.222	.018	.036	.098
	$\beta$	.209	.234	.595	.202	.210	.258
	(0.2) s	.034	.070	.492	.017	.039	.100
	a	.033	.068	.324	.016	.032	.095
	$\sigma_u^2$	.249	.251	.239	.251	.248	.248
	(0.25) s	.020	.040	.086	.011	.018	.038
	$R^2$	.922	.906	.504	.921	.907	.528
	s	.009	.022	.195	.005	.010	.129
2. Autocorrelated Income Shares	$\delta$	.042	.123	-.907	.019	.054	-.219
	(0.0) s	.215	.480	3.527	.105	.274	1.256
	a	.211	.464	3.025	.104	.221	1.145
	$\alpha$	.891	.869	.794	.897	.890	.893
	(0.9) s	.032	.071	.256	.016	.041	.123
	a	.031	.068	.222	.016	.032	.098
	$\beta$	.209	.236	.595	.202	.210	.258
	(0.2) s	.032	.069	.492	.015	.036	.100
	a	.031	.066	.324	.015	.031	.095
	$\sigma_u^2$	.249	.251	.239	.251	.248	.248
	(0.25) s	.020	.040	.086	.011	.018	.038
	$R^2$	.917	.898	.504	.917	.902	.528
	s	.013	.030	.195	.007	.015	.129
3. Compensatory Fiscal Policy	$\delta$	.041	.147	-.350	.017	.073	-.448
	(0.0) s	.242	.539	4.479	.126	.310	2.049
	a	.245	.536	4.490	.122	.257	2.059
	$\alpha$	.892	.869	.834	.897	.887	.923
	(0.9) s	.038	.082	.437	.019	.048	.212
	a	.037	.080	.431	.018	.038	.201
	$\beta$	.208	.233	.402	.202	.210	.243
	(0.2) s	.034	.071	.226	.017	.040	.091
	a	.033	.069	.197	.016	.033	.076

TABLE 1—(Continued)

Model Variation	Statistic	20-Year Histories			80-Year Histories		
		Micro	Semi-Aggregated	Aggregated	Micro	Semi-Aggregated	Aggregated
4. Balanced Budget Tax Policy	$\sigma_u^2$	.249	.251	.247	.251	.248	.248
	(0.25) s	.020	.040	.085	.011	.018	.039
	$R^2$	.922	.905	.337	.921	.905	.289
	s	.009	.023	.155	.005	.010	.079
	$\delta$	.083	.292	1.543	.023	.090	.141
	(0.0) s	.290	.599	6.711	.126	.263	1.416
	a	.282	.587	4.637	.119	.222	1.040
	$\alpha$	.889	.860	.645	.896	.884	.843
	(0.9) s	.035	.073	.212	.019	.041	.073
	a	.034	.070	.174	.018	.033	.059
	$\beta$	.210	.238	.487	.203	.212	.296
	(0.2) s	.032	.068	.995	.016	.035	.300
	a	.031	.065	.692	.016	.031	.224
	$\sigma_u^2$	.249	.251	.234	.251	.248	.247
	(0.25) s	.020	.040	.084	.011	.018	.038
	$R^2$	.954	.945	.623	.918	.911	.804
	s	.019	.025	.208	.039	.041	.101

\* Rows containing standard deviations of the experimental sampling distributions are preceded by an s. Rows containing average estimated standard errors are preceded by an a.

It is also apparent that the dispersion of the sampling distributions for the coefficients increases with aggregation somewhat more rapidly than would be expected from the simple loss of degrees of freedom. For example, in the 20-year histories case the sample sizes decline as 320:80:20, indicating that the sampling variance would increase as 1:4:16 or the standard deviation as 1:2:4. In Table 1 the pattern of standard deviations is more like 1:2.1:10. The reason is that there is feedback via the macroidentities and this becomes more important as aggregation is carried further. The explanatory variables Y and M are correlated much more closely at the fully aggregated level than at the micro-level. The resulting increase in collinearity presumably causes an incremental loss in addition to the lost degrees of freedom.

Comparison of the standard deviation and the square root of the estimated error variance columns in Table 1 reveal another tendency—namely that the latter have a nonconservative bias in the more highly aggregated case. In part this is illusory due to the fact that standard errors were averaged instead of the squares of the standard errors. But

the downward bias imparted by this is not large enough to explain the discrepancy. Detailed study of the individual regressions indicates a tendency to reject null hypotheses more frequently than the usual sampling theory would suggest.

*Autocorrelated Income Shares (Variation 2).* This variation introduces a minor complication which should not affect the macro estimates in any way. Only the distributive mechanism is affected, and the behavior of the macromodel should be entirely independent of this part of the model. In fact, since each variation was "started up" with the same initial values for the variables and for the random numbers, the results for the fully aggregated experiment are identical to those of the Primary Model. As compared with the primary experiment we note a slightly larger dispersion of regression coefficients at the microlevel which is underestimated, on the average, by the calculated standard errors. Except for that, the results are the same as the primary model and require no further discussion.

*Compensatory Fiscal Policy (Variation 3).* Some insight into the consequences of this variation may be obtained by examining the model which would hold if the government were able to forecast with perfect accuracy and hence stabilize disposable income perfectly. In this model the (constant) level of income is given and  $E$ ,  $G$ , and  $M$  are the endogenous variables. All three turn out to be autoregressive processes of the first order with the same autoregressive parameter, namely  $1-\beta$ .  $G$  and  $E$  will be perfectly correlated at the macrolevel and  $E$  will have a correlation of  $\sqrt{\beta}/2$  with the lagged value of  $M$ . Now, it is clearly impossible to estimate a coefficient for  $Y$  at the macrolevel because it shows no variation. Nevertheless, it is quite easy to get very good estimates at the microlevel. The variation of individual incomes is not eliminated by stabilizing aggregate income and this variation provides a sound basis for estimation.

The model chosen for this experiment was not, of course, so extreme. A limited ability to forecast (without bias) was assumed and a conservative policy aiming at partial compensation was attributed to the government. The results show a tendency in the direction indicated above, i.e., a marked deterioration in the ability to estimate the income parameter at the macro-level.

*Balanced Budget Policy (Variation 4).* This case may also be considered in an extreme form in which the government is able to forecast expenditures perfectly and sets tax rates so as to balance the budget exactly. In such a model, government income and expenditures must be identical because any divergence requires an unbalanced budget. If one considers the reciprocal of the tax rate, it turns out that this is perfectly correlated with  $Y$  (and  $E$ ). Moreover, everything has an autocorrelation

equal to  $\alpha$  (the income coefficient). So far as estimation in this extreme case is concerned, the situation is much as in Variation 3 except that the "money" coefficient is now the one that is obscured in the macrodata. The microdata, again, contain a practically undiminished amount of relevant information for estimation of both coefficients. This result is seen empirically in the large increase in the standard deviation of the estimate of  $\beta$  as we move from semi- to fully aggregated data.

### *Consequences of Misspecification*

In preliminary experiments several misspecified expenditure functions were fitted to the data at each level of aggregation. Only 25 replications of the 20 years per history cases were carried out.

The numerical results of the preliminary experiments are given in Orcutt and Watts [9] but are not duplicated here for the sake of brevity. Rather we summarize the notable results in the following paragraphs.

The correctly specified equation was adulterated by adding variables which should not be included. In one case the lagged value of the dependent variable was added, and in the other a second lagged value of income,  $Y-2$ , was introduced. In both cases the equations fitted at the disaggregated levels yielded inconsequential values for the "extra" variable and provided coefficients almost identical with those in the properly specified equation for the "correct" variables.

At the aggregate level the picture is quite different. For Variations 1 and 2, there is a perfect correlation between lagged income and lagged private expenditure (they are linked by an identity at the macrolevel). This fact implies exact collinearity when both are in the equation and prevents estimation altogether. Moreover, the same fit will be attained whichever one is left out. In Variations 3 and 4, the macroidentity is perturbed by random variation of either expenditures or tax rates. This allows estimation to proceed but the remaining collinearity makes the results very unreliable and sensitive to the difference in data generated by Variation 3 as compared to 4.

Another plausible misspecification—substitution of current income instead of lagged income—was included in the preliminary experiments. Current income was introduced alone, and in combination with lagged money. It will be recalled that income and expenditures are linked by an identity in Variations 1 and 2, and are closely correlated in Variations 3 and 4. In this case of misspecification these properties result in perfect fits at the aggregated level for 1 and 2. This situation is only slightly moderated in versions 3 and 4.

The estimates based on disaggregated data are relatively unaffected by these high macrocorrelations, with the exception of Variation 2 (autocorrelated income shares). In that case current income is, by virtue of autocorrelation, a good proxy for lagged income and hence partially picks up its effect when lagged income is absent.

### *Variance Estimation: Bias and Efficiency*

The results for all the experiments show negligible bias in estimating the variance of the stochastic term at the two low levels of aggregation and a small but detectable bias at the fully aggregated level. The *efficiency* of estimation declines in proportion to the loss in degrees of freedom. As will be recalled, we found a similar consequence for the parameter estimates themselves, although in that case the loss of efficiency was substantially greater than the expected proportional loss.

### *Loss of Information as a Function of Aggregation*

We now consider the amount of information in a body of data as a function of the extent of disaggregation. Since three aggregation levels were observed for each experiment we can get a crude idea about the shape of this function. The measure of lack of information content used here is mean square error which is the sum of the variance and the bias squared. Other measures of information are of course possible, but MSE is one which should enjoy general acceptance.

The MSE's for the coefficients  $\alpha$  and  $\beta$  in the correctly specified question are given in Table 2. One observes that moving from fully to semi-aggregated data increases the information (reduces MSE) much more than moving from semiaggregated to microcomponents, although at each step a four-fold division is made in the aggregation level.

## *IV. Conclusion*

The approach underlying this study was to construct a microanalytic model of the United States economy which was as realistic for a small model as our insight permitted. This primary model and several variants of it were then operated to produce large numbers of histories, and an effort was made to estimate the underlying structure of the generating models by conventional estimating techniques. By carrying out estimation on data at three levels of aggregation, including the national accounts level, it was possible to evaluate how the degree of aggregation influences the efficiency of conventional estimation techniques. We hope that these results can to some extent be carried over to estimations with "real" data.

We discovered that, if the real world is similar to any one of the variants which were tried, use of less aggregated data than the national accounts data presently relied on would make possible: (1) the virtual elimination of small sample biases, (2) enormous improvements in the precision of estimates of parameters in macroeconomic models, and (3) greatly improved possibilities of detecting misspecifications and of correctly choosing between alternative formulations.

Is at least one of our variants of the economy sufficiently like the real U.S. economy for our results to be of practical significance? If suitably

TABLE 2.—MEAN SQUARE ERROR FOR ESTIMATED COEFFICIENT  
(values are 10<sup>6</sup> times actual)

	Micro	Semi-Aggregated	Aggregated
Primary Model			
$\alpha$ (20)	152	733	7,677
$\alpha$ (80)	37	224	1,518
$\beta$ (20)	124	606	39,809
$\beta$ (80)	29	162	1,336
Autocorrelated Income Shares			
$\alpha$ (20)	110	600	7,677
$\alpha$ (80)	26	178	1,518
$\beta$ (20)	110	606	39,809
$\beta$ (80)	23	140	1,336
Compensatory Fiscal Policy			
$\alpha$ (20)	151	768	19,532
$\alpha$ (80)	37	247	4,547
$\beta$ (20)	122	613	9,188
$\beta$ (80)	29	170	1,013
Balanced Budget Policy			
$\alpha$ (20)	135	693	10,997
$\alpha$ (80)	38	194	858
$\beta$ (20)	112	607	107,239
$\beta$ (80)	27	137	9,922

disaggregated data were available, it would be possible to find out. Unfortunately our present available national accounts data are hardly adequate to let us learn. They are compatible with our underlying microanalytic model but, unfortunately, they contain so little evidence that they are compatible with all sorts of models. Perhaps this is why economic hypotheses and theories are almost never rejected on the basis of empirical evidence. If gains of the order found in this simple experiment could be obtained from suitable disaggregated or partially disaggregated real data perhaps some of these questions could be given a satisfactory answer.

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## ON THE SOCIAL RATE OF DISCOUNT

By WILLIAM J. BAUMOL\*

Few topics in our discipline rival the social rate of discount as a subject exhibiting simultaneously a very considerable degree of knowledge and a very substantial level of ignorance. Economists understand thoroughly just what this variable should measure: The opportunity cost of postponement of receipt of any benefit yielded by a public investment. They agree also on the components that should be considered in making up this figure: Primarily the welfare foregone by not having these benefits available for immediate consumption or reinvestment and (perhaps) a premium corresponding to the risk incurred in undertaking government projects. Above all, economists are quite generally in accord on the view that a very serious misallocation of resources can result from the use of an incorrect estimate of the value of this variable in a cost-benefit calculation. Yet, while they agree that externalities can play a significant role in the matter, there is some considerable question even about the direction of these effects. There is substantial obscurity and divergence of views in discussions of the implications of differences (if indeed there are any) in the degree of risk that is incurred when a given project is undertaken by a private firm on the one side and by government on the other. And as a result of these and other sources of shaky understanding of some basic principles, we are treated to what may with little exaggeration be described as a sorry spectacle—outstanding members of our profession providing in print estimates of the social discount rate ranging from four and one half to eight or nine percent. Some calculations by governmental agencies and others have even employed discount rates as low as three per cent (see March [10]) or have even discounted at a zero rate! (see Klarman [6]). Since the choice of investment projects can be so sensitive to the magnitude of this variable, little help is provided to the decision maker who is confronted by such an enormous range of estimates.

I do not presume in this paper to settle the major issues outstanding. But by going at the matter slowly and in terms of its elementary components I hope to introduce some illumination on these matters. It will be maintained however that there has been some misunderstanding of the relative magnitude of the components of the social discount rate.

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I will conclude that both risk and corporate taxes play a more important role than is sometimes ascribed to them, though, curiously, risk derives its significance from the comparative risklessness of investments from the point of view of society, the very fact that has played a central part in the argument of those who oppose the inclusion of a risk premium in the discount rate for government projects.

Perhaps more important, I will show that, given our institutional arrangements, there is an unavoidable indeterminacy in the choice of that rate. The figure which is optimal from the point of view of the allocation of resources between the private and public sectors is necessarily higher than that which accords with the public's subjective time preference. As a result, neither the higher nor the lower figure that has been proposed can, by itself, satisfy the requirements for an optimal allocation of resources, and we find ourselves forced to hunt for a solution in the dark jungles of the second best.

Finally, I shall suggest that the intertemporal externalities that have been discussed in the literature are significant for the overall levels of the optimal private and public discount rates rather than for the *differential* between the two rates. That is, if, e.g., externalities were in fact to imply that society invests too little for the future, then this means that the private and social rates should both be lowered, not that public projects should be evaluated in terms of a rate that is low relative to the cost of capital to private industry. I shall, then, reexamine the externalities issue and review the nature of the misallocations which are likely to result if inappropriate policy decisions are made in response to them.

In covering our subject it will prove convenient to proceed by stages, first dealing with a world in which taxes are present but in which there is no uncertainty and the role of time preference and externalities are ignored. In subsequent sections these other influences will be reintroduced one at a time and so we will be able to see more clearly the consequences of each.

### I. *The Basic Model: The Role of Taxes*

The basic premise on which the analysis will proceed is that the appropriate rate of discount for public projects is one which measures correctly the social opportunity cost. The decision to devote resources to investment in a public project means, given the overall level of employment in the economy, that these resources will become unavailable for use by the private sector. And this transfer should be undertaken whenever a potential project available to the government offers social benefits greater than the loss sustained by removing these resources from the private sector. The social rate of discount, then, must

be chosen in such a way that it leads to a positive number for the evaluated net benefits of a public project if and only if its gross benefits exceed its opportunity costs in the private sector. I repeat this banality because it seems to me to be the criterion which is relevant for investigations of the discount rate, and because it forms the basis for all of the discussion that follows.

Let us begin with a very simple model that brings out some of the critical elements in the analysis. For these purposes I utilize the following assumptions in the discussion of the present section, many of which will be dropped later in the paper: (1) The overall level of employment of all resources by the economy is fixed so that any increase in the use of resources by the public sector unavoidably produces a concomitant decrease in their utilization by private enterprise; (2) There is no risk or uncertainty—the future returns of any investment project can be foreseen perfectly. (We will return to the subject of risk in the next section); (3) All goods and services in the economy other than those provided by the government are supplied by corporations, an assumption which permits us to abstract from the difference in tax treatment of corporations and other types of firm; (4) Corporations in this riskless world are financed entirely by equity; (5) Corporate income is subject to a uniform tax rate of 50 per cent; (6) There is a unique rate of interest,  $r$ , at which the government borrows money.

Suppose now that the government considers undertaking a project whose construction requires the use of a set of input resources,  $R$ , for some given period of time. How does one calculate the opportunity cost of this use of resources? Since  $R$  is composed of inputs and since the corporations are the only alternative users of such items it follows that, in the first instance,  $R$  must all be obtained by taking it out of the hands of the corporations. The opportunity cost can then be calculated simply by determining the returns which could have been obtained if  $R$  had been left for corporate use during the period in question.

Our premises enable us to determine the equilibrium value of this magnitude, given the rate of interest on government securities. For in this riskless world investors will expect exactly the same rate of return on money invested either in the private or the public sectors. This means that the corporations must return  $r$  per cent to their stockholders. But with a 50 per cent tax on corporate earnings it follows that corporate resources must provide a gross yield of  $2r$ . In other words, the resources,  $R$ , if left in the private sector would have produced a real rate of return evaluated by the market at  $2r$ . For this purpose it makes no difference whether or not product prices are affected by monopolistic elements or other influences causing them to depart from competitive levels.<sup>1</sup> The

<sup>1</sup> However, externalities do make a difference. If a private firm obtains a private return on its

fact is simply that the transfer of our resources  $R$  has led to a reduction in outputs for which consumers would have been willing to pay enough to provide a rate of return  $2r$  on corporate capital. Specifically, even if a monopoly charges prices above marginal cost, its sales will be cut sufficiently so that its outputs' prices still represent the money measure of the goods' marginal utilities to their consumers.<sup>2</sup> Hence, with the usual reservations about interpersonal comparisons and income distribution these amounts do still represent the opportunity costs of the outputs foregone.

The form of this argument can easily lead to one sort of misunderstanding. It would seem to suggest that all government projects must draw their resources from private investment and that none of them can be taken from private consumption. But nothing of this sort is implied or intended. It is obviously possible that the steel used in some governmental undertaking is all taken from consumers and so results in no reduction in the output of producers' goods. The consequent decrease in manufacture of automobiles, refrigerators and bird cages then represents the real cost of the government project. But this in no way conflicts with my way of regarding the matter which states only that

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investment but imposes external costs equivalent to 3 per cent, the net social yield will obviously be only 12 per cent. For precisely the same sort of reason, as will be observed later, we may well consider it desirable to subsidize further the production of public goods in order to increase their output beyond its current level.

Note, incidentally, that the preceding argument does *not* necessarily imply that the individual firm can shift any or all of the burden of the corporate income tax. As with an increase in fixed costs under competitive equilibrium, the rise in taxes may raise the gross rate of return simply by driving some firms out of business even though no company can do anything about it.

<sup>2</sup> Professor Abba Lerner, in a letter to me, has commented on this point, suggesting that the presence of monopoly in the private sector does make a difference. "It is true that a dollar spent on the monopolized article yields the same marginal utility as one spent on an item produced under perfect competition, but the marginal return on the monopolized investment derives from the *marginal revenue* received by the monopolist and this is less than the *price*, so that there is here an additional reason for not taking resources away from the monopolist whose marginal social product is greater than his marginal private product because of his monopolistic restriction."

To put the argument another way, let  $p$ ,  $mc$ ,  $mr$  and  $I$  respectively represent price, marginal cost, marginal revenue and incremental investment, where the marginal cost includes no normal return, i.e., no "cost of capital." Then the monopolist will select an output at which his marginal rate of return on  $I$  is  $2r$ , i.e., at which  $(mr - mc)/I = 2r$  so that

$$I = (mr - mc)/2r.$$

But, using price as the measure of marginal consumer benefits, the social rate of return will then be

$$(p - mc)/I = 2r(p - mc)/(mr - mc).$$

Since price is normally larger than the monopolist's marginal revenue, this social opportunity cost figure will then be greater than  $2r$  and it may in fact be considerably greater. If, e.g.,  $p = \$2$ ,  $mc = \$1.40$  and  $mr = \$1.50$  the marginal social rate of return will then be  $12r$  while if  $mc = \$1.45$  this opportunity cost rate will rise to  $22r$ !

this transfer of resources must take place *through the agency of the corporation*. The automobile factory will have fewer tons of steel to process, as will the producer of refrigerators and other steel product consumer's goods. And I am arguing only that the outlays of these firms on the steel which they would otherwise have used would have brought them a rate of return of  $2r$  as a result of the consumers' marginal valuation of these commodities.

In these simple circumstances that is all there is to the matter. But it is important to bring out clearly how this discussion differs from much of the standard literature. This it does in two respects; in method of approach and in its implications for policy. In method, the approach of this model avoids the technique associated with Krutilla and Eckstein [7, ch. 4], (see also Otto Eckstein [3, pp. 81-104]) the attempt to trace out the sources of the money funds "used to finance" the project. Their method is to ask whether the adoption of the project will lead to further taxes or will be financed by further borrowing and seeks to measure opportunity cost by estimating the real consequences for the taxpayers or lenders involved. Such a calculation can easily be questioned from the viewpoint of the literature of functional finance which tells us that, in the last analysis, the purpose of such fiscal measures is not to "pay for" governmental activity, but to offset inflationary pressures. Real resources can be transferred to the government without either increased taxation or added borrowing from the public, inflation being left the task of providing the necessary forced saving. And, looked at from this point of view it is by no means obvious that the tax equivalent of a  $D$  dollar government expenditure is exactly  $D$  dollars in taxes. The balanced budget multiplier literature suggests strongly that it takes more than  $D$  dollars in taxes and borrowing from the private sector to offset the impact of a  $D$  dollar public outlay. But whether or not one is prepared to go along with this functional finance criticism of the sources of funds approach to the estimation of opportunity cost one can surely argue that the method is unnecessarily complex. If it is true that, in real terms, what the government takes from the private sector is input resources, then to determine the relevant rate of discount one need not inquire beyond the rate of return currently being earned by users of such inputs. One can ignore in this calculation the subjective time preferences of consumers, the difference between the disutility of paying taxes and of lending and a host of other issues which clutter unnecessarily some of the public project discount rate calculations. That the government's use of resources does deprive consumers of some goods is true but beside the point because consumers implicitly but very definitely indicate how they feel about this foregone consumption through the rate of return they are currently providing to business firms. And

the costs of taxation versus borrowing are considerations relevant to the choice of strategy of stabilization policy. They should not determine whether or not a specific project is undertaken.<sup>3</sup>

In addition, the proposed calculation has significant consequences for public policy, via its implication that, with a 5 per cent rate of interest on government bonds for the relevant time period, the correct rate of discount on government projects is not anything near 5 per cent but is on the order of 10 per cent per annum. This conclusion means that a number of longer-term government projects which are currently passing muster should be rejected. If this conclusion were accepted it might lead to very considerable changes in public investment programs—changes whose nature will be discussed later in this paper.<sup>4</sup>

## II. *Some Modifications: The Role of Risk*

So far the argument has deliberately abstracted from risk, a matter with which much of the discount rate discussion has concerned itself. A minor issue that arises from the presence of risk is that it leads corporations to finance themselves in part by means of debt rather than equity in the hope of attracting funds from investors who wish to limit their risk. Since in fact corporate income taxes apply neither to the interest payments on debt, nor to the earnings of firms which have avoided the corporate form of organization, one may conclude that our estimate of the opportunity cost of resources should be reduced somewhat below the figure of  $2r$  arrived at in the preceding section. One should decrease the figure for the corporate sector perhaps proportionately to its use of debt financing and then the overall discount figure should presumably be reduced in proportion to the resources that would come from noncorporate enterprises.<sup>5</sup>

<sup>3</sup> There is, however, a reasonable ground for objection to this last statement. If the decision to undertake a government project contributes to inflationary pressures the real cost or the cost of the counterinflationary measures should be deducted from the anticipated benefits of the project, and the reverse should hold in a period of unemployment where the calculation proposed in the text is incorrect in any event, since an increased use of resources by the government need require no corresponding reduction in their utilization by private industry.

<sup>4</sup> Readers will recognize that this conclusion has much in common with the views of Hirschleifer, DeHaven and Milliman [4, pp. 139–50]. However, we come to this result not entirely for the same reasons, as will be noted presently. On the other hand my position on this particular point is similar to one taken by Machlup [9] and by Vickrey in some brief remarks [16].

<sup>5</sup> That is, if  $e$  per cent of corporate financing is obtained from equity, and if  $c$  per cent of the government's input resources are derived from corporations, the social discount rate becomes

$$(1 - c)r + c[(1 - e)r + e(2r)] = r + cer.$$

Thus if, say, 80 per cent of the nation's goods and services were produced by the corporate sector ( $c=0.8$ ) and 80 per cent of corporate finances were accounted for by equity, one might estimate the discount rate for public projects at  $(1.64)r$ .

Even this smaller ratio may overstate the proper differential between this allocative discount rate and the bond rate of interest. It is easy to show that if a company's earnings are growing

But this is not the main issue in the risk discussion, which has centered about the role of risk in private borrowing, where, in addition to tax payments, investments must produce a rate of return sufficiently high to compensate the investor for the risks he undertakes in providing the finances to the company. Thus, suppose a private corporation earns 16 per cent on investment, half of which goes into taxes and, that of the remaining 8 per cent we have reason to suppose 3 per cent is a risk premium. Should the social rate of discount be 10 per cent (the 5 per cent riskless rate of return plus the tax payment on that amount) or should it be 16 per cent?

The argument for exclusion of a risk premium from the discount rate on public investment has been provided by economists as eminent as Samuelson [12] and Arrow [1]. It proceeds somewhat as follows. The government undertakes a very large number of highly variegated projects. Thus, under the law of large numbers, the overall outcome becomes virtually certain. On insurance principles, each one should be evaluated in terms of its expected value with no distinction made between projects whose outcomes have different dispersions. In such a context a project offering two possible payoffs, \$90 and \$110 with equal probability, is neither better nor worse than another offering \$50 or \$150 since each has an expected value of \$100.

It has been objected that one should take into account not only the total risk and the total expected yield of all government projects but also their *marginal* risk contribution and their *marginal* expected yield. It may appear at first glance that as a proportion of the government's total investment program both of these are apt to be insignificant for a single project, but that the ratio of the marginal risk to the marginal expected value contribution is not negligible. However, this view ignores some relevant considerations. If the outcomes of the various projects are independent, so that their covariance is zero (an assumption which is not obviously as valid a representation of the facts as is sometimes suggested—cf. Hirschleifer [5, pp. 268–75, esp. n. 6]) the distribution of the entire set of outcomes for all projects combined will tend to approach the normal distribution. Hence if the expected yield of a single representative project is  $y$  and its standard deviation is  $\sigma$ , for  $n$  projects the total expected yield will be  $yn$  while its standard deviation will be  $\sqrt{n}\sigma$ . A project's marginal contribution to expected yield will therefore be  $dy/dn = y$ , while its contribution to standard deviation will be  $\sigma/2\sqrt{n}$  which approaches zero with growing  $n$ . Thus if, for example, we

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at a rate  $g$  per annum then a 50 per cent tax rate will reduce the company's rate of return from  $P$  to  $P'$  where these are related by  $P = 2P' - g$ . Hence if  $g = 0$  the company will indeed have to earn  $2r$  to provide an investor a net return of  $r$  neglecting the considerations of the preceding paragraph. But if, say,  $g = .03$  and  $P'$ , the desired after tax rate, is .05, then  $P$ , the before tax rate, will be only  $2P' - g = .07$  per cent. I am indebted to E. P. Howrey for this observation.

consider as a rough measure of "safety level" (minimum anticipated earnings) a number  $k$  standard deviations below the mean, this figure for all government projects together will be  $yn - \sqrt{n}k\sigma$  and a project's marginal contribution to safety level will be  $y - k\sigma/2\sqrt{n}$  which for large values of  $n$  will be approximately equal to  $y$ , the project's expected yield.

But this still does not tell us about the opportunity cost. From the point of view of society (with the exception of one element that will be mentioned presently) a private project is equally riskless with a public one. Society benefits from the entire set of investment projects currently undertaken, whether they are public or private. The mere transfer of an investment's sponsorship from private hands to government does not per se affect its flow of benefits to society<sup>6</sup> nor does it mean that its risks are any more or less offsetable against the risks of other projects. That is to say, in line with the argument of the preceding paragraphs *all* investments should be evaluated at their expected earnings. Transfer into government hands may reduce the risk of an investment slightly in only one way. A private firm faces some danger of insolvency, in which case a project that has been undertaken may never be completed. Even here the distinction is not clear-cut; a change in administration with a new election can also cut off a public project before its invested resources can begin to bear fruit. But in any event, with increasing numbers of projects the marginal value of this sort of risk, too, will be negligible. Thus, from the social point of view the "law of large numbers" argument cuts both ways—it says that risk in either public or private projects is irrelevant for the returns society can expect.

But does this mean that the risk discount component in private cost of capital figures should be ignored in the social rate of discount calculation, as is often suggested in the literature? On the contrary, paradoxically, *the very absence of real risk means that the private risk discount should also enter the social discount rate*. Here private risk plays precisely the same role as the corporation tax. It induces firms to invest in such a way that the marginal investment yield is higher than it would other-

<sup>6</sup> In a letter William Whipple Jr. of Rutgers University has pointed out to me that this conclusion is not quite correct as it stands. When the resources are in private hands, the risk involved in their use constitutes a disutility to the investor, a psychic cost which has no counterpart in public investment. Hence, the removal of resources from the private sector where they yield a rate of return  $S$  involves an opportunity cost lower than  $S$  by the amount of this psychic cost to investors. It may perhaps even be argued that this investor risk disutility is exactly equal to the risk premium on private investment so that for this reason the rate of discount on government projects should include no risk premium, contrary to what is argued in this section on the basis of the evaluation of the yield of the resources *by consumers*. In any event, it is clear that the opportunity cost of the transfer must be larger than one would have thought if one had believed the returns to the private project to be uncertain from the point of view of society and there must therefore be some distortion in a discount rate on government projects that does not take into account the low social risk of private projects.



wise be. And the transfer of resources from the private sector therefore imposes a correspondingly high opportunity cost. Take the example of our corporation earning a 16 per cent rate of return, which in the absence of a risk premium would be reduced to 10 per cent. The expected return on its investment is then in fact 16 per cent which, as we have seen, is *virtually certain from the viewpoint of society*. Then, clearly, the social opportunity cost of a transfer of resources from the corporate to the public sector is 16 and not 10 per cent, and that is all there is to be said on the subject. It is irrelevant to argue that this high return is produced by artificial distortions—taxes, risks which for society do not exist, etc. The fact that the source of this rate of return is “artificial” makes the resulting yield figure no less substantive. Society cannot come out ahead by taking resources that have been bringing in annual benefits amounting to 16 per cent of the resource values and transferring them to uses where they will yield only 5 per cent.

### III. *Reassessment: Total Investment and its Allocation Between the Public and Private Sectors*

There are certain to be readers who find the preceding arguments to be offensive, and who will be led to this feeling by instincts that are perfectly reasonable. Surely, one may say, a 16 per cent discount rate means that far too little will be invested in the future. And in all this we have taken no account of the public's true preference and the relevant externalities. To some of these specific issues I will turn presently. But we should note first that this objection may well arise because we tend to overlook a distinction which has not often come across clearly in the literature. Involved in the choice of discount rate are several distinct issues:

(1) How much should be invested altogether? (2) How should this investment activity be divided up between the private and public sectors? (3) Given the level of investment of the public sector how much should be allocated to long-term projects—how much to short-term projects?

It must be emphasized that up to this point this paper has addressed itself exclusively to the second of these questions. It is perfectly consistent with what has been said for us to conclude in accord with the Pigovian point of view that our telescopic faculty is indeed defective. If so, the rate of interest on government securities should be lowered drastically. The value of  $r$  should perhaps be reduced by a cheap money policy to  $2\frac{1}{2}$  per cent. *But this should serve to encourage longer term investment by both the private and public sectors*, and, for example, in our riskless-world-with-corporate-tax model it does not in any way affect the

conclusion that the rate of discount on public projects should be  $2r$ , a figure which would in these circumstances fall to 5 per cent.

Thus, nothing said so far argues for or against low rates of discount. It states merely that society will not benefit if it increases long-term investment in a wasteful and inefficient manner, by forcing the transfer of resources from employments with a high marginal yield to uses with a low marginal yield. For that is exactly what can be expected to result from the usual sort of figure of, say, 5 per cent for discount rates on public projects when the corporate rate of return is perhaps three times that high.

#### IV. *The Role of Consumers' Subjective Time Preference*

But so far our leading actor has only been lurking in the wings. Where in all this is the subjective time preference? Is this, too, equal to some multiple of the rate of interest on government bonds? A moment's thought indicates that it is not. Suppose all consumers were willing to purchase government bonds at  $r$  per cent and were not doing so merely in response to appeals to their patriotism. This means, surely, that they consider the proposition to be good business, i.e., their time discount rate must then be no higher than  $r$  per cent. In practice the motive in buying government bonds may often be somewhat mixed, and not all persons hold some of these instruments. But it seems safe to conclude that at least for some members of the public  $r$  per cent is the riskless rate of time preference.<sup>7</sup>

We are thus left with the following unpleasant pair of conclusions: as we saw in the preceding section, efficiency in resource allocation between the private and public sectors requires a social rate of discount equal to  $kr$  where  $k$  is some number considerably greater than unity, because otherwise one would end up drawing resources from uses providing a return of  $kr$  and putting them into uses providing a far lower yield. Yet the public's time preference calls for a discount rate of  $r$  per cent for otherwise one allocates to the future resources much smaller than the amount desired by society. This observation immediately

<sup>7</sup> Or, more accurately,  $r$  per cent *exceeds* their time preference rate by the expected rate of rise in the price level plus some risk premium corresponding to the lenders' risk of being repaid in depreciated money.

In any event, the  $r$  per cent rate to be used in this calculation is surely the market yield to maturity of some government bond with a suitably long period of time to maturity. This observation offers no support to the rather curious discount rate calculation procedure currently utilized (under presidential directive) by the corps of engineers in the evaluation of water resource projects. Their figure is obtained by averaging the coupon rates (!) on all government securities "*which upon original issue, had terms to maturity of 15 years or more.*" Thus the June 30, 1965 discount rate of 3 1/8 per cent apparently included in its average bonds which had less than two years left to run and whose (nominal) coupon rate was 2 1/2 per cent.

suggests one explanation for the diversity of economists' views on our subject, a hypothesis which a study of the literature seems to confirm. Different writers seem to have focussed on different optimality conditions—some on the requirement for efficiency in the allocation between public and private investments, and others on the requirements of the private subjective time preference rate, and each has concluded that the discount rate that satisfied the one corresponding optimality requirement was in fact optimal.

However, we see now that no optimal rate exists. The rate that satisfies the one requirement cannot possibly meet the conditions of the other. In part the difficulty is caused by the corporate income tax which, our discussion suggests, may well be a very serious cause of resource misallocation in our economy.<sup>8</sup>

But even if the corporation tax were eliminated it would not solve the problem because of the risk premium on private investments. Repeal of the corporate income tax might, in line with our numerical example, reduce the rate of return to corporate resources from perhaps 16 down to 8 per cent. But it would never get it down to the illustrative 5 per cent on government bonds because of the risk incurred by the individual who lends his money to a private firm, a risk which for society is negligible. Since the discount rate cannot simultaneously be 5 and 8 per cent, one of the optimality requirements must still be violated unless a negative tax (a subsidy) on corporate investment were substituted for the corporation income tax.<sup>9</sup>

In the absence of such a subsidy there remains an inescapable indeterminacy in the choice of discount rate on government projects. There is perhaps something to be said for a figure higher than that currently employed on the grounds discussed in the preceding section. But if the discount rate is raised it should surely be done by all government agencies simultaneously. For otherwise the change will only produce wastes in the interagency allocation of resources beyond those that

<sup>8</sup> Or as Professor Lerner, in a letter to me, prefers to put it, "for avoidance of bias between public and private investment the public investment should pay the same taxes." Some writers, e.g., Whipple, have argued that tax-induced differences in opportunity cost rate such as that between the corporate and noncorporate sectors are a matter of deliberate policy, suggesting, in effect, that corporate activity generates undesirable externalities which Congress, in its wisdom, has implicitly decided to discourage. My opinion is that this is an excessively charitable view of the logic of the legislation which is a compound of expediency and failure to consider its consequences with sufficient care. Surely it requires a heroic reinterpretation of history to take the selection of a source of tax funds that is likely to cause little damage to the career of a politician and elevate it into a decision of high social principle.

<sup>9</sup> Hirshleifer [5, p. 270] recognizes the appropriateness of the risk compensating subsidy in these circumstances, and makes the very cogent remark that a larger subsidy would have to be paid to the small firm that incurs a substantial private risk than is given, say, to General Motors whose substantial number of investments offset one another's private risk to a considerable extent.

already characterize the apportionment of inputs between the government and private enterprise.

### *V. Investment as a Public Good: The Externalities Argument*

Since the time when Pigou wrote on the subject there has been an increase in the sophistication of the argument against a market-determined discount rate as the proper criterion for the quantity and durability of investment. But much of the literature seems to accept the view that a free market will make inadequate provision for the future and that therefore the social rate of discount should be lower than that which would produce market equilibrium.

Apparently the most widely accepted justification for this conclusion is one for which I must admit some degree of responsibility.<sup>10</sup> It maintains that the social yield of investment is characteristically higher than its private return so that on the usual logic of the externalities argument the market will not provide enough investment. Specifically, there are three reasons why this is apt to be the case:

1. A project undertaken by an individual incurs a risk to him much greater than that which it imposes on society. Part of the source of this divergence has already been discussed—the insurance to society provided by the many projects simultaneously engaged in by the economy.

2. But there is another and perhaps equally significant reason for the distinction. A project undertaken by a private individual may for financial or other reasons be taken from him before he receives all of its benefits; he may lose it by going bankrupt, or he may die without heirs. Yet in either of these cases the benefits accrue unimpaired to society. Inheritance taxes clearly cause a substantial divergence between private and public returns from long-term investment.

3. Investment in the future is of the character of a public good. National pride leads many of us to want a promising future for our country. Or looked at the other way, many of us have an uneasy conscience at leaving to future generations a world despoiled and deprived of its productive capacity. But as with national defense, it is impossible to provide a brilliant future for the nation to one of today's citizens without simultaneously making it available to all.

<sup>10</sup> See Baumol [2], pp. 131–32. On the subsequent literature see Marglin [11] and Sen [13] [14]. The more recent of Sen's papers makes a very useful distinction between two related arguments on these matters: the "isolation paradox" whereby it pays no individual to save an optimal amount, whether or not everyone else does so, and the "assurance problem" in which the individual will save enough only if he is assured that others will also do so. Sen is right in pointing out that my argument seems to fall into the latter category. But that is a matter of careless phrasing on my part. On this I need not merely rely on distant memory which reminds me that I was well aware of the relevance of the prisoner's dilemma analogy when I wrote the passage in question. The discussion in Section 3 of my Chapter 11 makes the distinction between the two cases in some detail even if in a somewhat obscure manner.

These are all classic grounds for encouragement of additional supply and the direction of their force is clear. Yet when they were recently recapitulated, cogently argued and their implications explored by Marglin, his conclusions were strongly disputed in two replies.<sup>11</sup> One of these dealt primarily with what, for present purposes, may be considered technicalities and so it need not concern us here, though it is certainly worth reading. However, the other note, that by Tullock, makes an important point which in my view goes far to offset the conclusions implied by the externalities argument.

Tullock points out that an increase in investment, aside from its allocative consequences, constitutes a redistribution of income from present to future generations. That being so, he reminds us, it is incumbent on us to ask ourselves whether we really want to undertake such a redistribution of income—as in any such redivision of the pie the answer depends heavily on who the recipients are to be, and on their economic circumstances. In particular, in our economy if past trends and current developments are any guide, a redistribution to provide more for the future may be described as a Robin Hood activity stood on its head—it takes from the poor to give to the rich. Average real per capita income a century hence is likely to be a sizeable multiple of its present value. Why should I give up part of my income to help support someone else with an income several times my own?<sup>12</sup>

Tullock puts the matter in a more attractive light by posing the alternative in a different way. Suppose we feel we can afford to give up some fixed amount for the benefit of others. We must then ask ourselves whether there are so few diseased, illiterate, underprivileged today, so few persons who excite our sympathy that we must look to the prospectively wealthy future for a source of worthy recipients of our bounty.

Let us then pull together the pieces of the argument and see where they lead. We have seen that there is a basic contradiction in the optimality requirements for the social rate of discount. The condition for efficiency in the allocation of resources between the private and public sectors requires a discount rate significantly higher than that called for by the public's time preferences. Only by the elimination of the corporate income tax and the substitution of a subsidy to private investment

<sup>11</sup> See Lind [8] and Tullock [15].

<sup>12</sup> Of course, if the capital market were perfect the discount rate would fully take into account the prospective rate of increase in real incomes. This is why I find Sen's argument [14] convincing for the pure competitive model but not for decision making in practice. Under pure competition the differences in present and future wealth will be reflected fully in the market's discount rate so that the reluctance to invest described by the Marglin-Sen-Baumol argument will certainly make for a misallocation of resources. In practice, where capital markets are riddled with imperfections and subject to the tergiversations of government policy it is my judgment that the probable wealth of future generations is given inadequate weight in interest rate policy so that the Marlin-Sen-Baumol externalities may well prove benign in their effects.

to offset the difference between public and private risks can the two requirements be reconciled. Since neither of these changes seems, to say the least, very likely to be instituted in the foreseeable future, some arbitrary choice will have to be made. It is my inclination at the moment to look with some favor at a figure toward the higher end of the range—at a discount rate closer to what may be considered the cost of capital to private firms. My grounds for this preference are hardly convincing even to me—they rest largely on the feeling that there is a very tangible loss in the transfer of resources from a high rate of return use to an employment in which their yield is very low. On the other hand I can attribute much less significance to a time preference rate which is constantly shifted about and made to adjust to the dictates of monetary policy.

My other major conclusion (which, unavoidably, is also largely a matter of opinion) would appear to be that in our economy, by and large, the future can be left to take care of itself. There is no need to lower artificially the social rate of discount in order to increase further the prospective wealth of future generations. The rate of interest should presumably then be set by the market and the needs of public policy—the requirements of stabilization, equilibrium in international trade, etc., and no attempt should be made to subsidize the future by artificial reductions in discount rates designed only for that purpose.

However, this does not mean that the future should in every respect be left to the mercy of the free market. There are important externalities and investments of the public goods variety which cry for special attention. Irreversibilities constitute a prime example. If we poison our soil so that never again will it be the same, if we destroy the Grand Canyon and turn it into a hydroelectric plant, we give up assets which like Goldsmith's bold peasantry, "... their country's pride, when once destroy'd can never be supplied." All the wealth and resources of future generations will not suffice to restore them. Investment in the preservation of such items then seems perfectly proper, but for this purpose the appropriate instrument would appear to be a set of selective subsidies rather than a low general discount rate that encourages indiscriminately all sorts of investment programs whether or not they are relevant.

Moreover, one can envision circumstances in which a more general program of encouragement to investment commends itself to us. In a country which is stagnating and where only a major restriction of current consumption can put life into its development program, one may well wish to make the sacrifice for tomorrow, for in such a case, without it the future generation will be as impoverished as the present.

There is a final consequence of the Tullock suggestion which should not be overlooked. The idea that we may want to redistribute income in favor of the poor of today's generation rather than the future poor is

not an argument against government activity. On the contrary, it is perfectly consistent with the rather persuasive Galbraithian view that the supply of public goods is far too small. We may want far more governmental activity than is currently being undertaken to remove today's slums, to combat today's air pollution, to help put down today's crime. But wanting *more* government projects is not tantamount to a desire for more *long-term* government projects. What our society's interests may well require is more but less durable government investments, and a low rate of discount on public projects is precisely the wrong way to go about their achievement.

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## THE RUBLE EXCHANGE RATE AND SOVIET FOREIGN TRADE PRICING POLICIES, 1929-1961

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The purpose of this paper is to investigate some aspects of Soviet practices and policies with regard to export and import pricing and the ruble exchange rate. The need for special investigation arises out of a number of peculiar institutional circumstances under which Soviet foreign trade is conducted: the existence of a foreign trade monopoly which transacts all imports and exports; the inconvertibility of the ruble; the inconvertibility of the currencies of other Bloc nations with which the Soviet Union now transacts the bulk of its trade on a strictly bilateral-balance basis; and a highly manipulated internal price structure which differs markedly from that of any Western nation. The peculiar structure of internal prices is the result of: insensitivity to short-run supply and demand forces; failure to include capital costs and rent in price; the inclusion of an item, profit, which probably has borne little or no quantitative relationship to profit in the Western sense; the employment of very large and discriminatory sales taxes (turnover tax) on consumers' goods often amounting to an average markup of 100 per cent; and the granting of large subsidies to producers' goods industries which have, at times, been required to support prices as much as 50 per cent below cost.

Soviet foreign trade pricing is by no means a complete mystery. On the basis of elementary trade theory, it is obvious that, in Soviet trade with Western nations, prices must be somewhere in the neighborhood of world prices since the Soviet Union is a small competitor on a large market and must generally play the role of price-taker. We also know that in trade with the advanced Western nations, at least in the postwar period, the Soviets have been discriminated against, having to sell at lower than, and buy at higher than, world prices for a majority of commodities [11] [12] [19]. In intra-bloc trade, a large number of pricing options are open in theory, and the Bloc nations have indeed bent constant effort since at least 1950 to find a pricing basis of their "own." This to be expected for reasons of prestige and because they conduct about two-thirds of their trade with each other. However,

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because of the irrationality of their respective internal price systems, inconvertibility of currencies, and bilateral trading practices, an "own" pricing system has so far not been generated. Instead, according to Bloc economists, they trade with each other at some approximation to the world prices of a given year. While world prices are used as a starting point for negotiations, they are adjusted for transport differentials, various short-run "speculative" fluctuations, for differences in comparative advantage relative to the world market, and so forth. World prices of a given year have typically been adhered to from three to seven years regardless of changing market conditions [18, Ch. 8].

In the study which follows, Soviet foreign trade prices (average unit values) are compared with Soviet domestic prices for a number of years. The study will demonstrate that Soviet foreign trade prices, based as they are on world prices, are not related at all to domestic prices. It will also enable us to determine, roughly, the extent of under- or overvaluation of the ruble and the rationale behind various changes in the official exchange rate which have occurred over the past 35 years. Finally, the study will consider some of the pricing problems that Soviet planners face in attempting to trade "effectively" and rationally. These latter problems, which face all the Bloc nations, have led to a major theoretical outpouring in the Eastern economic journals over the past seven or eight years [6] [8] [23] [27].

### I. Procedure

We compare the unit values of Soviet exports and imports with Soviet internal prices of the same commodities for the years 1929, 1935, 1937, and 1956. The choice of years was based partly on data availability. The Soviets have not issued detailed trade returns for the years from 1941 through 1954 so that comparisons for these years could not be made. Trade returns by country and by commodity are available for the years prior to 1941 and for the period after 1955. Domestic wholesale prices of a large number of important producers' goods and raw materials are available in a series of *Research Memoranda* for the period 1928 through 1956 as a result of the laborious combing of Soviet price handbooks by a group of workers at RAND Corporation under the overall supervision of Professor Abram Bergson. The general change in Soviet wholesale prices on July 1, 1955, and absence of change in 1956 made the year 1956 the more convenient one for postwar comparisons. The general overhaul of internal wholesale prices on April 1, 1936 and the simultaneous 77 per cent devaluation of the foreign exchange ruble made it desirable not to use this year for comparison. On the other hand, 1935 and 1937 were both of interest, providing, as they did, a look at price relationships before and after the price reforms and devaluation.

The year 1937 was one in which internal wholesale prices of producers' goods and raw materials probably more closely represented "cost of production" than in any other year of the 'thirties, subsidies having just been largely removed. Turnover taxes on consumers' goods remained as large as ever, of course. On the other hand, 1935 was undoubtedly the year of largest price subsidies in the prewar period. The year 1929 was chosen for investigation because it represented the first full year of "five year planning." Further, both wholesale and retail prices more closely represented true cost of production in this year, which preceded the great proliferation of subsidies and sales taxes of the early 'thirties.

The estimates presented below leave much to be desired in the way of comparability and coverage and should be taken to represent only general orders of magnitude—crude indicators of Soviet foreign trade price policy. Some of the data problems which had to be faced are described briefly below.

The major difficulty in obtaining wide coverage resulted from the fact that the foreign-trade commodity breakdowns were usually not as refined as those presented in domestic internal price lists. It is difficult to make comparisons, in any case, because there are so few truly homogeneous commodities. It is not possible to say, for example, that the hard coal exported is of the same quality as that included in the domestic price list and that the prices are therefore precisely comparable. But the error here is probably small in comparison with the differentials being measured. In the case of machinery products, however, an important class of goods in Soviet trade, it was impossible to make any comparisons at all for some years because of the wide range (in prices) of domestically sold products which had to be compared with each item in the foreign trade nomenclature. In general, where more than one domestically sold commodity appeared comparable to an export or import, comparisons based on the average domestic price were nevertheless included under two sets of circumstances: where the price differentials of the domestically sold goods were small; and where, even though the price differentials were somewhat larger, the prices of all domestically sold commodities deviated very substantially and in the same direction from the foreign trade unit value.

Exports are priced F.O.B. Soviet border for the whole period under consideration. Because the border is so far from the point of origin of most shipments to China, Mongolia, and other Far Eastern nations, these shipments were usually eliminated in computing average unit values. Soviet imports were valued F.O.B. the country of shipment in 1956 but C.I.F. (Soviet border) in the prewar period. The internal Soviet prices which are used here for comparison are, with few excep-

tions, F.O.B. factory, mine, or supply depot. This means that the export and import unit values will have an upward bias relative to internal prices due to the inclusion of transport costs.

Consumers' goods prices include, as we have already noted, a very substantial sales or turnover tax which, on the average, has typically amounted to more than 50 per cent of final price and which has varied from 0 to 90 per cent of price for individual commodities. It would be desirable, in making comparisons with export and import unit values, to make estimates both net and gross of taxes. Unfortunately, for most of the commodities involved, individual tax rates are not available. Therefore, the "net of tax" adjustment cannot be made on a commodity basis. We do, however, make a rough aggregative adjustment on the assumption that the rate of sales tax on the consumers' goods that enter foreign trade is equal to the average rate on all consumers' goods sold by state and cooperative stores to the population.

The formula used for aggregating the ratios of domestic to foreign trade prices to get a measure  $V_{dx}$  (or  $V_{dm}$ ) of the over- or undervaluation of the foreign trade ruble is:

$$V_{dx} = \frac{\sum_x \frac{P_d}{P_x} P_x Q_x}{\sum_x P_x Q_x}$$

where  $P$  and  $Q$  refer to prices and quantities, respectively, the subscript  $d$  refers to domestic internal price and  $x$  to export unit value. Substitute  $m$ 's for  $x$ 's for the domestic price-import comparisons,  $V_{dm}$ . This formula amounts to a weighted average of the ratios of domestic price to unit values, the weights being based on the quantities of exports (imports) in our sample.<sup>1</sup>

## II. *Average Trends: the Value of the Foreign Trade Ruble*

The results for 1929, 1935, 1937, and 1956 are presented in Tables 1 and 2. There are two separate aspects of these results that deserve separate treatment: the aggregate relationships between foreign trade and domestic prices to be examined directly below; and the large variance for individual commodities around these aggregate relationships, to be considered later.

<sup>1</sup> It would have been more desirable to have first aggregated the commodities in our sample by commodity group and then to have aggregated the groups by their relative importance in total Soviet exports or imports. This was not done for two reasons. First, within-group variance was often very large. Second, in some instances large groups were represented by small samples. In light of the large within-group variance, it seemed unwise to bestow upon the small samples the heavy weight of the group. The only exception was consumers' goods where the ratios of internal price to unit value differed substantially and consistently from the ratios of other groups.

TABLE 1—RATIO OF INTERNAL PRICE TO EXPORT UNIT VALUE 1929, 1935, 1937, 1956

	1929	1935	1937	1956
Producers' Goods and Raw Materials				
Coal and coke	1.06	2.43	0.93 <sup>a</sup>	1.25
Petroleum products	3.76 <sup>b</sup>	36.37 <sup>a</sup>	6.23 <sup>a</sup>	3.04
Iron and manganese ores	0.64	1.92 <sup>d</sup>	0.45	—
Ferrous metal products and alloys	0.98	4.25	1.00	1.50
Nonferrous metals and products	—	3.15 <sup>e</sup>	1.26 <sup>e</sup>	2.66
Chemicals, varnish, paints, etc.	1.56 <sup>f</sup>	4.67 <sup>g</sup>	1.33 <sup>g</sup>	4.56
Turpentine	3.24	8.08 <sup>b</sup>	4.05	—
Cement	1.47	5.48	0.89	1.17 <sup>i</sup>
Lumber and lumber products	1.60	3.69	0.99	1.98
Grain	—	—	—	2.14
Total producers' goods	2.50	12.00	2.16	2.11 (1.90) <sup>m</sup>
Total producers' goods, turnover tax removed from petroleum products	—	—	1.19	—
Total producers' goods, excluding petroleum and products	1.36	3.52	0.95	1.87 (1.68) <sup>m</sup>
Consumers' Goods				
Food	1.69	—	11.75	10.95
Industrial goods	—	—	13.07	4.21
Total consumers' goods	1.69	—	11.82	9.16
Total consumers' goods adjusted for turnover tax	1.27	—	4.73	4.58
Weighted <sup>k</sup> total exports, unadjusted	2.30	6.38	4.09	3.12
Weighted total exports, consumers' goods adjusted for turnover tax	2.19	—	2.67	2.47
Sample of exports as per cent of total	38%	29%	43.5%	29.5%

<sup>a</sup> Coal and peat.

<sup>b</sup> Includes crude petroleum.

<sup>c</sup> Export unit values taken from 1936 since breakdown for 1937 unavailable.

<sup>d</sup> Includes steel scrap.

<sup>e</sup> Very small amount.

<sup>f</sup> Soda ash and caustic soda only.

<sup>g</sup> Chemicals and paints.

<sup>h</sup> Includes resin.

<sup>i</sup> Includes firebrick.

<sup>k</sup> Consumers' and producers' goods are weighted by their proportions of total exports. Subcategories are weighted simply by their values in the sample. A weighting of subcategories by proportion of the subcategory in total exports yielded the following results which do not differ significantly from the above:

Total producers' goods	2.37	12.85	2.02	2.16
Total producers' goods, excluding petroleum products	1.44	3.61	0.97	1.92

<sup>m</sup> Based on estimate of effect of including machinery and equipment.

<sup>n</sup> Due to high gasoline and kerosene ratios. Other petroleum ratios <10.

### *Foreign Trade Average Unit Values Versus Domestic Prices*

A number of different measures are presented in Tables 1 and 2 of the aggregate relationships between Soviet domestic and foreign trade prices each of which answers a somewhat different question. Ratios are

TABLE 2—RATIO OF INTERNAL PRICE TO IMPORT UNIT VALUE 1935, 1937, 1956

	1935	1937	1956
Producers' Goods and Raw Materials			
Coal and coke	—	—	1.29
Petroleum products	3.17	—	4.59
Ferrous metals, products and alloys	—	—	1.59
Ferrous metal products	1.84	0.78	—
Nonferrous metals and products	4.89	—	7.18 <sup>a</sup>
Copper ingots	—	1.03	—
Chemicals and enamels	—	—	2.56
Chemicals and paints	2.24	—	—
Cement, brick, firebrick	—	3.35	—
Cement	12.8	—	3.16
Lumber and products	4.23	1.18	1.50
Grain	—	—	2.40
Total producers' goods	3.53	0.98	3.24
Total producers' goods, excluding petroleum and products	3.53	0.98	2.88
Consumers' Goods			
Food and cigarettes	—	25.55	8.69
Industrial	—	—	12.45
Total consumers' goods	—	25.55	9.68
Total adjusted for turnover tax	—	10.22	4.84
Weighted grand total: including turnover tax	—	5.24	4.85
adjusted for turnover tax	—	2.69	3.63
Samples as per cent of total	10.1%	14.8%	17.0%

\* The ratio for tin is 10.98. Since the value of tin is high in the nonferrous metals group, the high group ratio reflects the tin ratio.

presented for: producers' goods, producers' goods excluding petroleum and products, consumers' goods, consumers' goods adjusted for turnover tax, and combinations of these. In a formal purchasing power parity sense, weighted total exports and imports, unadjusted for turnover taxes, provide the truest measure of the value of the foreign exchange ruble since they are based on *actual* Soviet internal prices. In practice, however, there is good reason to believe that the planners, to

the extent that prices are a relevant variable in their decisions regarding exports and imports, tend to look at prices net, rather than gross, of turnover tax (discussed below). From this point of view, the most relevant ratio of domestic to foreign trade prices is that of producers' goods excluding petroleum and products. We exclude consumers' goods because, although we have made an aggregate adjustment designed to get a ratio for consumers' goods net of the turnover tax, this is an extremely crude adjustment based on an approximation to the average rate of turnover tax on consumers' goods and may not be too accurate for the samples which are exported and imported, respectively. We exclude petroleum products for most purposes because they also are subject to a very large turnover tax which, except for 1937, cannot be quantified. Our discussion, then, centers around the ratio for producers' goods excluding petroleum and products. By restricting ourselves largely to such producers' goods, we are, in effect, comparing domestic wholesale price, excluding turnover taxes, with export and import average unit values. Wholesale price probably very roughly approximates average cost of production, as the Soviets measure it, with the exception of the year 1935, at which time large subsidies were being granted to producers' goods industries. Therefore, wholesale prices were considerably below "cost-price" in that year.

The comparisons in Tables 1 and 2, of Soviet domestic prices with export and import prices reveal that the Soviets were both selling to and buying from foreigners at prices which were substantially below domestic wholesale price (and even further below consumers' goods retail prices) in 1929, 1935,<sup>2</sup> and 1956; on the other hand, domestic and foreign trade prices were roughly equivalent in 1937.

To belabor the obvious, it is clear that foreign trade prices have not been based on domestic costs or prices since, with the exception of the year 1937, they have been substantially below domestic prices. The correspondence of domestic and foreign trade prices in 1937 is a coincidence resulting from the ruble devaluation of 1936 (see below) that brought world and domestic wholesale prices of traded goods more or less into line.

The results for 1929 are roughly confirmed by a recently published Soviet source [1, p. 74] which suggests that in 1928 (and we assume the same for 1929)<sup>3</sup> a 32 per cent devaluation would have brought export prices into line with domestic prices. I have compared Soviet export prices in 1929 with world prices of the same commodities (using U.S. export prices as my surrogate for world prices) to find that the Soviets were exporting at 46 per cent below world prices. One possible explana-

<sup>2</sup> Even farther below the true "cost-price" of producers' goods in 1935 because of subsidies.

<sup>3</sup> Prices changed little between 1928 and 1929.

tion is that hostility of other nations to trade with the Soviet made it necessary for them to undercut substantially their competitors in order to enter foreign markets. As one Soviet writer has put it, exports in this period had to be increased in the face of ". . . embargoes, customs and currency restrictions, higher tariffs, and other anti-Soviet measures. . . ." [20, p. 10]. If this was the case, then the overvaluation of the foreign exchange ruble cannot be attributed exclusively to internal Soviet prices being out of line with world prices but also to the unfavorable competitive situation the Soviets faced in world markets.

### *A Check on our Estimates*

Since rather small samples were used in comparing foreign trade and internal prices, it would be useful to check these results with independent data, if possible. This can be done by comparing trends in domestic and foreign trade prices and using these trends to extrapolate between benchmark years: 1929, 1935, 1937, and 1956. We confine the extrapolations to exports. As already indicated, since the figures in Tables 1 and 2 were computed, a Soviet economist, I. Aizenberg [1, p. 74], has provided an independent estimate of the overvaluation of the ruble for 1928, *viz.* 32 per cent.<sup>4</sup>

If our measurement for 1929 indicates a correct order of magnitude of ruble overvaluation, then it is possible to check our estimate for 1935 by comparing the 1929-1935 trends in export and domestic prices, respectively. According to a Soviet study (Table 3), Soviet export prices had declined by 1935 to 44 per cent of their 1929 level. In comparison the internal price index of basic industrial goods excluding petroleum products rose by 5 percent and, including petroleum products, by 55 per cent [5].<sup>5</sup> Consumers' goods prices rose much more rapidly—by several hundred per cent over this six-year period. Extrapolating the 1929 ratios yields ratios of 8.82 and 3.25 for producers' goods including and excluding petroleum, respectively. These provide a "rough" corroboration of our figures of 12.00 and 3.52 respectively.<sup>6</sup>

The Soviet export price index rises by 37.3 per cent from 1935 to 1937. Over the same period the internal price level of basic industrial

<sup>4</sup> Aizenberg's estimate is based on comparing trends in world and domestic prices from 1913 to 1928.

<sup>5</sup> Cost-prices were rising much more rapidly but were not reflected in wholesale prices as a result of which subsidies rose quickly.

<sup>6</sup> Bakulin and Mishustin [3, pp. 284-87] present a League of Nations index and a German index both of which show a greater drop in Soviet export prices and, therefore, a larger ratio of domestic to export prices for 1935 than does the Soviet index. This could explain much of the discrepancy between 8.82 and 12.00. The discrepancy also may have a "weighting" dimension: while the rise in petroleum product prices was responsible for the rapid rise in 1935 of the internal price index of industrial goods, exports of kerosene and gasoline declined from 14.9 to 3.4 per cent of total exports between 1929 and 1935 [3, p. 282].

TABLE 3—SOVIET EXPORT PRICE, IMPORT PRICE, AND TERMS OF TRADE INDEXES

	Export Price Index	Import Price Index	Terms of Trade Index	
1929	100.0	100.0	100.0	
1930	82.7	85.1	97.2	
1931	60.1	77.1	77.3	
1932	48.7	68.0	71.6	
1933	45.2	63.2	71.5	
1934	44.0	56.0	78.6	
1935	44.0	52.8	83.3	
1936	49.3	54.1	91.1	
1937	60.4	63.9	94.5	
1938 (1st 9 months)	51.1	59.2	86.3	
1938	100	100	100	
1946	245	188	(112.4)	130.3
1950	233	210	(95.8)	110.0
1955	254	243	(90.2)	104.5
1956	250	247	(87.3)	101.2
1957	254	251	(87.3)	101.2
1958	242	232	(90.0)	104.3
1959	233	224	(89.7)	104.0
1960	237	227	(90.1)	104.4

*Source:* For the periods 1929 to 1st 3 quarters of 1938, see [3, pp. 284-87]. These indexes are based on 1929 weights. For the period 1938-60, estimates are made by dividing indexes of value of exports and imports calculated from trade figures by volume indexes presented in [31]. The terms of trade index is extended from 1929 through 1960 (the figures in parentheses) by a simple link in 1938 between the two sets of price figures.

goods including petroleum rises 44.7 per cent and excluding petroleum by 70 per cent. The ruble underwent a 77.2 per cent (1/4.38) devaluation on April 1, 1936, a measure clearly aimed at correcting the disparity between internal and foreign trade prices (see below). Using these facts to extrapolate yields the following results. Extrapolation from our directly estimated figures for 1935 yields ratios of domestic price to export unit values for 1937 of 2.89 (including petroleum) and 1.00. Extrapolation based on the 1935 extrapolated ratios (of the preceding paragraph) yields ratios for 1937 of 2.13 and 0.92, respectively. These latter figures are almost identical with, and the former indicate a similar direction and order of magnitude of change, as represented by our directly estimated figures for 1937 of 2.16 and 0.95 (Table 1).

From 1938 to 1956, the prices that the Soviets obtained for their exports increased by 250 per cent (Table 3). The prices of basic industrial goods rose by 214 (including petroleum) per cent and 276 per cent [5].<sup>7</sup>

<sup>7</sup> It should be noted that in terms of domestic wholesale prices of producers' goods, the ruble probably became increasingly undervalued from 1938 (when it was roughly in purchasing



In addition, in 1950 the ruble was revalued upward by 32.5 per cent, changing in value from 5.3 to 4.0 to the dollar. Extrapolating trends (ignoring the minor devaluation from 1937 to 1938) results in ratios of 2.46 and 1.39 for basic industrial goods, including and excluding petroleum products, respectively. These ratios are not far from our directly estimated ratios for 1956 of 2.11 and 1.87, respectively.<sup>8</sup> There is an important reason, however, for suspecting that our directly estimated ratios overstate the overvaluation of the ruble in 1956. Because it has been impossible to compare prices of exported machinery with domestic prices of the same items, machinery price ratios have been systematically excluded from our estimates. According to a Soviet source, machinery prices declined by 40 per cent from 1948 to 1955 whereas prices of heavy industry products in general declined by only 8 to 10 per cent [30, p. 21]. Since machinery prices in the United States and in Western Europe rose substantially in this period, and since the Soviets probably did not reduce their export prices to the full extent of the differential between Soviet internal and world prices, it may be deduced that the domestic price/export unit value ratio for machinery products was declining relative to ratios for other products. Machinery products, it should be noted, accounted for 17 1/2 per cent of total exports in 1956. If the differential price trends between machinery products and other heavy industrial products can be assumed to have been reflected in lower ratios, then the aggregate ratios for 1956 can be estimated to have been in the neighborhood of 190 and 168, including and excluding petroleum products, respectively. A summary view of trends from 1929 to 1961 is presented in Figure 1.

### III. *Exchange Rate Policy?*

The data presented above have conclusively demonstrated that the ruble exchange rate did not equate the average internal price level of all

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power equilibrium) to 1948. Wholesale prices of basic industrial goods rose by only 25 per cent, including petroleum products, and 38 per cent excluding petroleum products, in this period. The export price index (Table 3) on the other hand had increased by 146 per cent from 1938 to 1946 declining slightly thereafter. The wholesale prices of basic industrial goods rose so little, of course, because of the huge subsidies which were granted and were not removed until 1949 at which time prices more than doubled. In terms of real costs, then, the ruble was undoubtedly overvalued during this whole period.

<sup>8</sup> It may seem slightly paradoxical that the extrapolated ratio including petroleum is 2.45, i.e., higher than the directly estimated ratio of 2.11 whereas the extrapolated ratio excluding petroleum of 1.39 is lower than the directly estimated ratio of 1.87. This strange result is due to the fact that the petroleum product ratio declines sharply over the period 1938-1956 whereas all other ratios rise rather sharply; and the price trend figures, which include petroleum products, are extrapolated equally from the 1937 ratios, including and excluding, petroleum products. Presumably the paradox would be eliminated if we could have extrapolated the 1937 ratio, excluding petroleum products. For this reason, the directly estimated figure is assumed to have a higher degree of validity than the extrapolated figure.

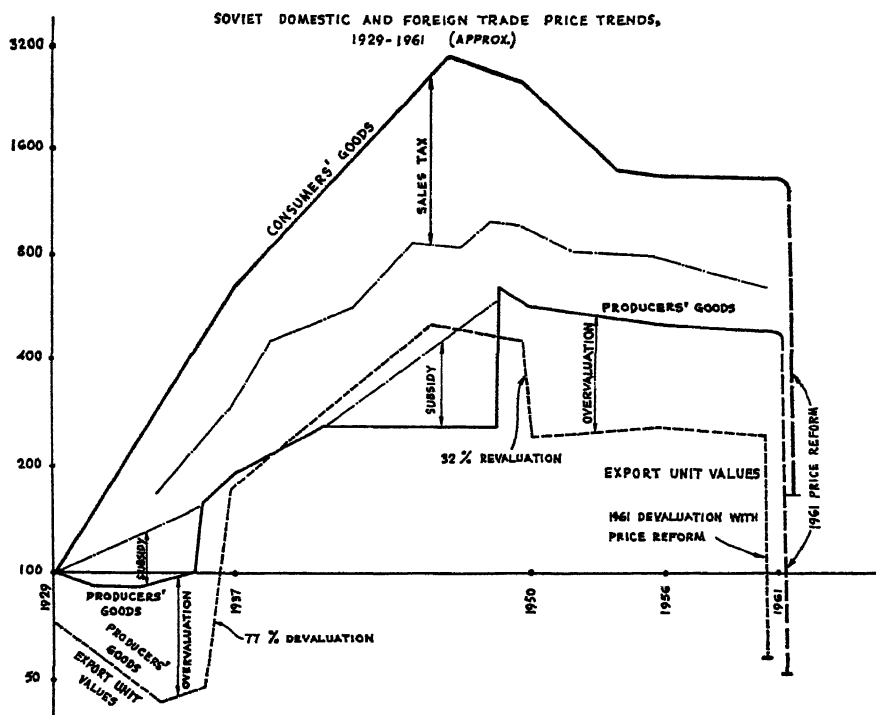


FIGURE 1

commodities (including consumers' goods and petroleum products) exported and imported by the Soviets with their prices in international trade and did not equate these prices for the most important class of traded goods, producers' goods and raw materials excluding petroleum products, except in the year 1937 (and perhaps for some years shortly thereafter) and, as we see below, since 1961. Clearly, the ruble exchange rate has probably been for extended periods of time, further out of "equilibrium" in the sense of equating internal and external prices (or costs) of tradeables<sup>9</sup> than the exchange rate of any Western nation.

<sup>9</sup> We use the term "equilibrium" in this very limited purchasing power parity sense throughout the paper in full knowledge of the fact that none of the conditions for determining the true economic equilibrium value for the ruble exists. In most years, the Soviets have traded at far below the optimum volume [10], have rigidly controlled trade through direct controls, and have had an internal economy beset with repressed inflation. Unfortunately, space limitations prevent me from discussing the question of "true equilibrium" further here. Other issues which cannot be pursued here for lack of space are: the implications of the data for the question of dumping; differences between degrees of overvaluation of exports and imports; the unique Soviet practice of revaluing all previous foreign trade returns every time the exchange rate is changed; and the implication of our figures for valuation of foreign trade in the national income accounts.

Balance in the current account has, of course, been maintained by as extensive a system of controls as has ever been applied to the foreign trade of a nation. The exchange rate has served as little more than an accounting device for converting foreign currency prices of Soviet exports and imports into rubles for the purpose of constructing foreign trade accounts in local currency. Despite the fact that the ruble exchange rate apparently has played no significant role as a "price" in foreign economic relationships, the Soviet have nevertheless seen fit to make three major, and several minor, changes in the exchange rate over the past 30 years. These changes and the reasons behind them will be discussed briefly below.<sup>10</sup>

### *The 1936 Devaluation*

The ruble was valued in terms of dollars at \$0.5146 from before World War I until the devaluation of the dollar on January 1, 1934. At that time, the ruble-dollar rate was raised to \$0.8712 per ruble and the ruble was usually quoted at 13.1 francs per ruble since the franc was still on gold. On January 1, 1936 a special tourist rate of 3 francs per ruble went into effect; this new rate was generalized to all transactions on April 1, 1936. As noted earlier, this enormous devaluation put the ruble at 23 per cent (1/4.38) of its former value. In terms of dollars, the ruble declined in value from \$0.8712 to \$0.1992.<sup>11</sup> As we have seen, the ruble was grossly overvalued before devaluation and devaluation largely equalized the domestic wholesale<sup>12</sup> and foreign prices of tradeables as our ratios (Tables 1 and 2) for 1937 suggest. Actually, the percentage of devaluation is larger than the drop in ratios of domestic to foreign trade prices from 1935 to 1937 as shown in Tables 1 and 2. This is reconciled by: (1) the devaluation more or less coinciding with the partial elimination of domestic subsidies on producers' goods and raw materials (excluding petroleum products) which raised internal prices abruptly by 52 per cent in 1936 and by another 11 per cent in 1937; and (2) the smaller rise of about 37 per cent (Table 3) in Soviet export prices over these two years.

Why did the Soviets bother to devalue in 1936? The reason given by Aizenberg, the one Soviet economist who has discussed the devaluation

<sup>10</sup> We are concerned here with only the official exchange rate, not with either the tourist rate or the so-called non commercial rate. On these latter rates see [21, App. B].

<sup>11</sup> The ruble was slightly devalued on July 19, 1937 to \$0.1887 or 5.3 rubles to the dollar.

<sup>12</sup> It did not, of course, equalize prices for consumers' goods and petroleum products, both of which included large turnover taxes. It is worthy of note that Soviet exports (imports) were only 1/2 per cent of GNP in 1937 [10]. Given this low volume of trade, one would expect that internal prices of exports would be considerably below, and of imports, considerably above average unit values if the Soviets were maximizing comparative advantages. However, the data in Tables 1 and 2 give roughly the same average ratios for exports and imports of producers' goods excluding petroleum products.

candidly, is: preservation of managerial incentives [1] [15]. To understand this reason, one must understand the financial operations of Soviet foreign trade organizations with an overvalued exchange rate. The overvalued ruble has meant for Soviet foreign trade organizations that exports must be sold on the average at much below cost (to the organization) involving a large nominal loss; whereas imports can be purchased from abroad at prices much below their subsequent transfer price to the domestic Soviet buyer involving large nominal profits [16]. Where losses are sustained, the organization receives a compensating subsidy from the budget; where large profits result, these are transferred automatically to the state budget. When subsidies and/or profits are very large, Soviet experience has demonstrated that it is very difficult to keep managers striving for efficiency, i.e., keeping down operating costs and striving to sell at high and buy at low prices.<sup>13</sup> This was a major factor behind the Soviet attempt to eliminate subsidies to domestic industrial enterprises in 1936, and was apparently the major reason for the devaluation undertaken (not by accident) at the same time. *Thus*, the ruble exchange rate at this time *did* have a link with the economy, albeit a weak one, through the impact of extraordinary profits and losses on managerial incentives in foreign trade organizations.

### *The 1950 Revaluation*

The ruble remained stable at 5.3 to the dollar until March 1, 1950 at which time its value was raised to 4 to the dollar, a 32.5 per cent increase in value from \$0.1887 to \$0.25. This upward revaluation of the ruble was defended on the general grounds that Soviet prices had declined since World War II whereas capitalist, and especially U.S. prices had risen.<sup>14</sup> This statement contains elements of truth but is not entirely relevant as a rationalization of the revaluation. The elements of truth are the rising Western prices and the fact that, after the Monetary Reform of December 1947, prices of consumers' goods declined sharply in the Soviet Union. However, because consumers' goods amount to only a small fraction of Soviet trade and because their prices contain an enormous sales tax element, this trend has little significance for the change in exchange rate. What is significant is the relationship between domestic price trends of nonconsumption goods and world price trends as reflected in the Soviet export (import) price index (Table 3). Between 1937 (1938), at which time the ruble was "correctly" valued, and 1950, domestic prices of producers' goods and raw materials, excluding

<sup>13</sup> Why this is so is explained in [14, Ch. 4].

<sup>14</sup> While Aizenberg [1, pp. 145ff.] was very candid about the overvaluation in the twenties and thirties, he joins other Soviet commentators in repeating this specious rationalization of the March 1, 1950 revaluation.

petroleum products, increased by 205 per cent [5],<sup>15</sup> whereas the Soviet export price index which reflects trends in world prices increased by only 133 per cent. This suggests an overvaluation in 1950 of roughly 30 per cent. This estimate is corroborated by extrapolating back to 1950 from our 1956 ratio of domestic price to export unit value of 1.87 (1.68): the export price index rises 7 per cent (Table 3) while the wholesale price index of producers' goods and raw materials declines by about 11 per cent, again suggesting an overvaluation of 50 per cent (35 per cent) before the revaluation in March 1950.<sup>16</sup>

If the ruble was overvalued in 1950, why did the Soviets increase its nominal value still further and thereby increase its degree of purchasing power parity "disequilibrium"? There does not appear to have been any economic justification for this step as there was for the 1936 devaluation. The only explanation which comes to mind is the politico-economic one of increasing the prestige of the ruble despite the adverse effect of revaluation on incentives. The new Soviet trading bloc was expanding rapidly in this period but all transactions were being conducted either on a barter basis or in Western currencies. Soviet writings in the late 'forties stressed the future role of the ruble as key currency in these transactions. While upward revaluation of the ruble certainly could not have increased its usefulness in performing this economic function, it may nevertheless have been designed to create this impression.

The validity of politico-economic interpretation of the revaluation is reinforced by the fact that the Soviets took advantage of the opportunity to define the value of the ruble in terms of gold rather than in terms of dollars as it had been since July 1937. In the words of the decree, "From March 1, 1950, the rate of exchange of the ruble with respect to foreign currencies shall not be concluded on the basis of the dollar but shall be transferred to the more stable gold standard, increasing the gold content of the ruble . . ." [29, p. 22].

Still one additional explanation of the revaluation has been offered by Michael Kaser [18, p. 32]. He claims that the higher value of the ruble increased the costs to foreign governments of maintaining embassies and sending trade delegations to the U.S.S.R. and suggests that this, in addition to prestige, may have influenced the decision to revalue. In my opinion, this consideration could not have been significant enough quantitatively to have been more than of secondary importance.

<sup>15</sup> Virtually all of this increase occurred in 1949. In fact, prices declined in 1950. The rise in 1949 was designed to eliminate subsidies.

<sup>16</sup> The overvaluation would have been higher yet, of course, if consumers' goods and petroleum products had been included in the estimate. This is true despite the relatively rapid decline in consumers' goods prices in the postwar years and the relatively declining ratio of domestic price to export unit value of petroleum products *because* their absolute ratios were, in 1950, still so much higher than those of other commodities.

*The 1961 Devaluation*

The most recent change in value of the ruble was the devaluation put into effect on January 1, 1961,<sup>17</sup> as part of a more general Currency Reform. The devaluation was not heralded as such but was in fact claimed by the Soviets to be an appreciation of the ruble; however, this claim was false. The Reform consisted of two parts: first, all internal prices, wages, deposits, etc., were reduced in value by a factor of 10 (thereby leaving all Soviet citizens unaffected by the Reform); second, the value of the ruble was raised from \$.25 to \$1.11, or, in terms of gold, from .222168 grams to .987412 grams. The reason why the change in value of the foreign exchange ruble represented a depreciation rather than appreciation should now be apparent. Despite the fact that internal prices of traded goods were reduced tenfold, the ruble was not increased in value by tenfold (or more) but by a factor of only 4.44. This amounts to a 55.6 per cent depreciation. Further, it implies that if the depreciation brought the ruble into "equilibrium" in the purchasing power parity sense, internal prices of tradeables before the Reform must have been 2.25 ( $10 \div 4.44$ ) times higher than export (import) unit values.

The question is: did the devaluation bring the ruble into "equilibrium"? As we have seen (Table 1), internal prices of producers' goods and raw materials (excluding petroleum products) were estimated at 1.87 (1.68) times higher than export unit values in 1956. Since 1956, internal prices remained virtually stable whereas the price index of Soviet exports declined (by 1960) by 5 per cent (Table 3). Extrapolating these trends suggests that the ratio had risen slightly by 1961 to about 2.00 (1.75). If this ratio is the correct one, then the Soviets should have devalued by 50 per cent (45 per cent) rather than by 55.6 per cent. That is to say, the January 1, 1961 devaluation resulted in an undervaluation of the ruble. Of course, our figures are not so precise that we can claim to estimate the value of the ruble accurately within the limits under discussion. Furthermore, if petroleum products are taken into account, it might be argued that the devaluation did not go quite far enough.<sup>18,19</sup> My own inclination is that the Soviets more or less correctly

<sup>17</sup> This was preceded by the establishment of a 10 ruble to the dollar rate on April 1, 1957, applicable to expenditures by tourists, diplomatic missions, etc. in the Soviet Union. This, and other aspects of the recent devaluation, are outlined and analyzed by Bornstein [7].

<sup>18</sup> Harry Schwartz argued [22] that the devaluation did not go far enough since, at the new exchange rate, comparison of Moscow and New York prices of 23 consumers' goods shows the Soviet price higher in 19 instances, New York price higher in 2 cases, and prices equal in 2 cases. This argument has limited validity for several reasons: (1) consumers' goods comprise a small percentage of total goods traded by the Soviets; (2) an exchange rate can only be expected to equate the prices of traded commodities and many of the commodities in this sample are not traded on world markets; (3) finally, as we have seen, the Soviets have at least a double price system with consumers' goods prices containing a large element of sales tax which is (sensibly) netted out by the planners in making their foreign trade decisions. See Figure 1. It is worth noting, however, that the unification of tourist and official exchange rates involved an

estimated (or slightly overestimated) the amount of overvaluation, and the devaluation was designed, as in 1936, to bring the ruble into equilibrium in the purchasing power parity sense. One of the reasons for wanting to do so was, as in 1936, to improve the incentives of management in the foreign trade organizations. The extent to which an "equilibrium" exchange rate succeeds in this task is reduced, of course, by the fact that the internal price/export unit value ratio varies so much among commodities. The variance in ratios also makes it difficult to take very seriously the argument of some Soviet economists that the change in the exchange rate was designed to make it easier to evaluate the profitability of foreign trade by making Soviet and world prices more comparable. While true, this rationale is trivial. The principal difficulty in judging the effectiveness of foreign trade comes not from aggregate overvaluation which is easy for the planners to discount [15], but from the irrationality of internal prices (Section IV).

The devaluation was also designed, as in the case of the 1950 revaluation, to enhance the prestige of the ruble. This is the reason why it was combined with a 10-fold deflation of internal prices. In fact, the basic reason behind the deflation may have been to create the illusion that the depreciation was, in fact, an appreciation. The stated reasons for the deflation appear to be trivial [7]. Again, presumably the Soviets are interested in enhancing the prestige of the ruble in order to boost it for greater use in world, and particularly in intra-bloc, trade. It cannot serve this function, of course, until a number of other conditions are fulfilled [13, pp. 242-50] including the introduction of rational pricing systems in the U.S.S.R. and member bloc nations and until substantial changes are made in methods of central planning.<sup>20</sup>

#### IV. *Price Ratio Variance*

In previous sections we have discussed the aggregate ratios for traded goods of domestic prices and world prices to average unit values of ex-

11 per cent increase in the cost of the ruble from tourists' point of view. This is because the tourist now had to pay \$1.11 for rubles which previously had cost \$.10 in the face of a ten-fold reduction in prices.

<sup>19</sup> It should also be noted that imports were more overvalued than exports and required greater devaluation.

<sup>20</sup> Pryor [21, p. 242] presents another argument for the devaluation. He points out that before 1957 service transactions were all concluded on the basis of official exchange rates and, moreover, there are many nonstandardized articles like machinery and materiel which are valued on a cost-plus basis and converted to rubles also at the official exchange rate. Since the ruble was, before 1961, probably overvalued vis-à-vis all Eastern European currencies but the Polish Zloty, transactions were advantageous to the Russians. This was rectified in the case of service transactions by the establishment in 1957 of special intra-bloc so-called noncommercial exchange rates which were closer to a purchasing power parity. The injustice persisted in the case of nonstandardized products and this, according to Pryor, was one reason behind the general change in bloc exchange rates in 1961.

ports and imports. It is quite obvious from a cursory examination of the figures in Tables 1-2 that these aggregates represent the averages of very wide spectrums of individual group ratios. The individual group ratios themselves represent averages of individual commodities and therefore understate the width of the spectrums, as the figures in Table 4 (which disaggregate Table 1) indicate.<sup>21</sup> The significance of the aggregate ratios as discussed above is reduced to some extent by the existence of such large degrees of variance. While we cannot pretend to explain each instance of a ratio deviating from unity and from the overall average, some deviations are specifically explainable and others, though not individually identifiable, can be explained in terms of three or four important variables or factors. We are referring to: the deviation of the exchange rate from an "equilibrium" value; the rationality of prices, both for individual commodities and for groups of commodities (as a result of turnover taxes on consumers' goods and the subsidizing of producers' goods); the rationality or irrationality of those making foreign trade decisions; and the often large difference, under Soviet conditions of planning, between short-run opportunity costs and long-run costs. The significance of these factors, if not obvious, is made clear below.

Before turning to the cases of particular commodities, it should be noted that the ratios in Table 4 are presented in order from the highest to the lowest. Starred ratios indicate degrees of overvaluation as measured in Table 1. If internal prices were rational, and only the exchange rate were in "disequilibrium" (in the purchasing power parity sense), then it would be true that all commodities above the star (or upper star) were being sold at a loss, all below the star (or lower star) at a profit, the percentage of profit or loss varying directly with the degree of deviation from the average (level of overvaluation). To the extent that prices are rational, one might expect the Soviets to export relatively large quantities of commodities with low ratios and relatively small quantities of commodities with high ratios. A check along these lines showed little or no correlation between ratios and quantities.

Assuming that both internal prices and planners are rational, why is it that the Soviets presumably export some commodities at a nominal loss and others at a nominal profit with little correlation between profits and quantities exported? Many of the commodities exported by the Soviets are dictated not so much by careful consideration of possible nominal profits as by relatively fortuitous circumstances such as the particular commodities desired by particular trading partners and which

<sup>21</sup> We do not bother to present the disaggregation of the domestic price: import average unit value ratios of Table 2 since these largely duplicate the domestic price: export average values presented in Table 4.



TABLE 4—INDIVIDUAL RATIOS OF DOMESTIC PRICE TO EXPORT UNIT VALUES:  
1929, 1937, 1956

1929		1937		1956	
gasoline	4.41	consumers' goods	11.82	tin	10.98
naphtha	4.17	kerosene	10.39	consumers' goods	9.16
fuel oil	4.15	gasoline	10.36	turpentine	8.21
lubricating oil	3.70	turpentine	4.05	lead metal and alloys	4.95
turpentine	3.24	lubricating oil	3.65	fuel oil	4.59
kerosene	2.45	fuel oil	2.55	caustic soda	3.98
crude oil	2.31	aluminum sheet	2.16	blackplate steel-iron	3.50
consumers' goods	1.69	copper semifabs	1.69	gasoline	3.48
caustic soda	1.63	tin ingot	1.67	kerosene	2.81
sawn lumber	1.63	carbon steel tools	1.56	sawn lumber	2.81
cement	1.47	plywood	1.44	zinc metal and alloys	2.83
plywood	1.46	paints	1.41	roofing steel-iron	2.46
	1.36*	pitprops	1.36	diesel fuel	2.41
bituminous coal	1.30	calcium carbide	1.34	assorted varnish	2.35
rolled steel rails	1.19	steel scrap	1.26	aluminum	2.26
coke	1.15	shamot bricks	1.22	pitprops	2.16
foundry cast iron	1.09		1.19*	plywood	2.12
conversion iron	.96	steel sheet	1.16	cement	2.07
lime	.94	steel girders and			1.87*
anthracite coal	.87	beams	1.11	pig iron	1.82
rolled steel sheet	.83	foundry cast iron	1.11	soda ash	1.81
rolled steel plate	.68	bituminous coal	1.10	ferro-manganese	
soda ash	.67	steel bars	1.10	alloys	1.72
manganese ore	.66	steel angles	1.09		1.68*
iron ore	.57	sulphuric acid	1.07	rolled copper	1.65
		welded steel gas-		lubricating oil	1.60
		water pipes	1.06	cold rolled packing	
		rr. ties	1.02	band	1.57
		steel squares	.97	dynamo steel	1.53
		steel rounds	.96	rolled brass	1.50
			.95*	copper ingots	1.45
		sawn lumber	.90	wire nails	1.43
		conversion iron	.90	rails	1.38
		cement	.89	steel bars and sections	1.38
		copper ingot	.88	rolled wire rods	1.37
		anthracite coal	.86	beams and girders	1.34
		steel rails	.85	sheet steel	1.32
		ferro-manganese		coking coal	1.29
		alloys	.82	copper trolley wire	1.28
		lead ingots	.59	gas and water pipe	1.26
		steel plate	.56	rolled aluminum	1.26
		peat	.45	bituminous coal	1.24
		manganese ore	.47	anthracite coal	1.24
		iron ore	.32	steel cable	1.20
				ferro-silicon alloys	1.17
				rr ties	.95
				assorted wire	.84
				fire brick	.53

\* Starred ratios indicate degree (range) of ruble overvaluation from Table 1.

commodities happen to be in relative excess supply (or demand) at any particular time. Faced with the problem of financing imports of essential (to the plan) commodities, the Soviets may be willing to sell at prices considerably below cost even after allowance for overvaluation. Selling below cost may not involve a "real" loss, however; the profitability of Soviet foreign trade may sometimes be assessed not in terms of exports and imports viewed as separate transactions but rather in terms of exports viewed as payments for imports. The loss on an export is compensated for by the profit on an import. Similarly, the Soviets may pay more for an import than the cost of producing a substitute. This may be justified as rational in at least two circumstances. First, the import may be financed, bilaterally, by the export of a commodity on which an even larger profit is earned. Second, the import may be necessary to eliminate an unforeseen bottleneck which cannot, in the short run, be handled out of current production. That is to say, the short-run opportunity cost of the commodity to be imported may be much higher than its long-run average or marginal cost.<sup>22</sup> I submit that these considerations undoubtedly explain some of the deviations observed.

We have been assuming that prices and planners are rational. This is certainly not true of prices, either in terms of Western theoretical standards or according to the standards of Eastern economists and central planners. As noted above, an extensive discussion in the Eastern journals has centered on these very problems of irrational pricing and the determination of "what" to trade [8] [27]. A well-known Soviet economist, G. Smirnov [24, p. 10], has pessimistically pointed out:

As shown by the preliminary study, a more or less complete and acceptable analysis of the economic effectiveness of the foreign trade of the Soviet Union in the first stage is possible on the basis of development of 200-250 coefficients which characterize the deviation of effective internal selling prices of exported and imported goods from their full production costs in the U.S.S.R.

It hardly need be added that the ratios of Table 4 are akin to "coefficients" to the extent that prices are irrational.<sup>23</sup> The Soviet Union has in fact, been far behind the other bloc nations in both the theory and practice trying to work effectively in international trade with irrational internal prices. Both Poland and Hungary developed and were actually using "coefficients" or "notional" exchange rates for different commodities at least by the late 1950s. For example, while officially the Polish zloty was worth 4 to the dollar, some of the notional rates were: all

<sup>22</sup> Soviet attempts in 1959-60 to import oil pipe line and whole factories to produce plastics and chemicals fall in this category.

<sup>23</sup> In the 1956 case, the ratios would have to be adjusted for the degree of overvaluation.

imports—40; all exports—16; brown coal—4; all coal—8.8; cotton and silk fabrics—200; food—36; all other goods—24. Examples of Hungarian notional rates were: official rate—12 forints to the dollar; crude aluminum, locomotives, cotton cloth, and shoes—25.8; wheat—35.2; live pigs—47 [25, Ch. VI, p. 29] [26, p. 70].

We turn now to discuss a few of the ratios in Tables 1 and 4. The most dramatic deviations from the average are the domestic price: average unit value ratios for consumers' goods. These are a consequence of the dual price system that results from almost exclusive use of large turnover taxes to bridge the *ex ante* inflationary gap. As a first approximation, one might say that these high ratios represent the case of "irrational prices and rational planners," decisions based on a "second best" strategy. That is to say, the planners know that consumers' goods prices are abnormally high as a result of the use of sales rather than income taxes to bridge the "gap" and sensibly base their decisions to export and import on prices net of tax. Actually, not enough information is available to judge whether each particular purchase or sale is rational or not; for this it would be necessary to know the price net of tax of individual commodities and how these net prices compared with average unit values.

Almost comparably large deviations from domestic price exist for some petroleum products as for consumers' goods. The proximate cause—a large turnover tax—is the same in both cases. However, the function served by the turnover tax differs between them. In the case of consumers' goods, the turnover tax is simply a markup to bridge the inflationary gap. The turnover tax on petroleum products, on the other hand, presumably represents the rent on or value of land which contains petroleum reserves [9, p. 12]. That is to say, the turnover tax on petroleum products represents a factor cost, that on consumers' goods does not. If the turnover tax on petroleum products accurately represents the differential rent on petroleum lands, petroleum products are in effect exported at substantially below cost even after allowance is made for the overvaluation of the ruble. The high domestic price: average unit value ratios, in this case, then appear to represent "rational prices and irrational planners" especially for the years 1929 and 1937. Two mitigating considerations should be mentioned. First, the turnover tax should probably not be taken to represent, accurately, the differential rent on petroleum land. For one thing, the rates have been extremely high; in 1937, for example, the turnover tax amounted to the following percentages of price: gasoline—78 per cent; kerosene—88.3 per cent; and fuel oil—60.5 per cent [28]. Such high rates and consequent high prices may overstate the value of petroleum products to the planners. However, it should be noted that the 1937 net prices (before

turnover tax) of both gasoline and kerosene were still higher than the average unit values at which they were exported. Second, petroleum products represent a very complicated case of joint supply. The imputation of cost to the various joint products is extremely tricky, at best. Furthermore, with given types of production equipment and different grades of crude oil, it is not always possible to produce the precisely desired product-mix; or on the other hand it may be possible to produce extra quantities of some items (gasoline, kerosene) for export at very little extra cost. Under either of these conditions, the planners might well maintain high domestic prices to restrict domestic consumption (or for "irrational" reasons) but be willing to sell at much lower prices on world markets because either the opportunity cost to them of the exported items was small or because the marginal costs of production (however imputed) were small.<sup>24</sup>

The highest ratio for 1956 is that of tin which represents a very special case. The relatively high internal price of tin may represent either the high direct outlay costs of producing tin in the Soviet Union, a marginal producer, or, as in the case of petroleum, may be the result of the levy of a large turnover tax. In either event, the significance of the high internal price of tin for exports is strongly mediated by the fact that the Soviets import a large part of their tin requirements and it is these imports which are, in effect, re-exported and at approximately the same price. In recent years, virtually all tin imports have come from China. Since China has a difficult time financing its imports from the U.S.S.R., transshipment of tin could be looked upon, from our point of view, simply as a device to facilitate the financing of Sino-Soviet trade.

The domestic price: export unit value ratio for turpentine is consistently high. Turpentine is probably produced as a by-product of the lumber industry. As such, the Soviets may well produce more than they need for domestic consumption. If this is the case, the relatively high internal price of turpentine may be classified as one of the many "irrational" prices found in the Soviet Union. The high ratio and concomitant export would be a result of "irrational prices and rational planners."

Iron ore, manganese ore, and anthracite coal consistently fall among the lower domestic prices: export unit value ratios, particularly in 1929 and 1937. This fact suggests that exports of these commodities resulted in large profits to the Soviets. These profits are overstated, in western terms, because of the failure of the Soviets to account for rent on mining land, to allow for depletion, and to include a charge for capital in these highly capital-intensive industries and, perhaps, because some enter-

<sup>24</sup> These comments are purely hypothetical, of course. I am not acquainted with the detailed petroleum situation in the U.S.S.R.

prises have experienced operating losses and received subsidies. In fact, Smirnov [24] argues that the real value of the products of mining are presently undervalued by more than 35 per cent as a result of poor pricing and this may be the extent of the undervaluation of these goods in 1956, implying no excess profits from trade. But even the inclusion of all missing charges would probably not have brought the ratios up to the average in 1929 and 1937, and exports must in any event have been quite profitable.<sup>25</sup> Conceivably, the Soviets could profitably have exported still greater quantities of each of these commodities even though this might have involved lower export prices and/or higher marginal production costs. The very low ratios could reflect a failure on the part of the planners to respond fully to profit-making opportunities in foreign markets, as well as the unresponsiveness of internal prices to external prices and to demand conditions in general.<sup>26</sup> The deviant ratios for these commodities might represent, then, in part, "irrational prices" as well as in part, "irrational planners."

This completes our very inadequate analysis of the large observed variance in the ratios of domestic prices to export and import average unit values. It seems reasonable to assume that that part of the variance due to irrational prices may have been reduced by the price reforms of the past few years.

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<sup>25</sup> The mining industries received very large subsidies sometime after 1929 and before 1936, but presumably much of these were eliminated by 1937.

<sup>26</sup> Becker [4] has computed ruble-dollar ratios for more than 500 producer durables for the year 1955. His figures show a very wide variance around the mean and median (which vary from about 2-1/2 to 7 depending on weighting). Those commodities which have very low ratios are commodities in which the Soviets presumably have a comparative advantage vis-à-vis the United States. That many of these items are not exported suggests that profit-making opportunities in foreign trade are not taken full advantage of.

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## ON ESTIMATING THE INDUSTRY PRODUCTION FUNCTION

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The purpose of this paper is to present an estimation technique which allows the economist to make a traditional interpretation of an empirically estimated microproduction function where the underlying production process is assumed to be deterministic. To be specific, we may estimate with mathematical programming a production function for the firm which can be "so defined that it expresses the *maximum product* obtainable from the (input) combination at the existing state of technical knowledge" [2a, pp. 14-15].

We shall argue here that the distinguishing features of firm production for a given industry may be embodied in attained values for certain technical parameters in an "industry" production function, differences in them reflecting relative scales of operation, varying organizational structures, etc. In the spirit of M. J. Farrell [5] [6] who constructs an envelope isoquant for the industry, the "industry" production function is conceptually a frontier of potential attainment for given input combinations. The production function for any particular firm may conceptually be obtained from the industry function in terms of the firm's ability to implement optimal values of parameters in the industry.

Of course the frontier concept is not new, but heretofore our available quantitative tools have forced an unusual amount of effort to be directed toward the interpretation of fitted functions—their meaning in light of the accepted theory, questions of identification of production functions versus factor demand equations and/or output supply equations, and the like. A justification for this effort is that regression analysis and the estimation techniques available for multi-equation systems depend upon the specification of stochastic terms with zero means. For the goal of fitting a function through a series of observations on firms for output and several inputs, this implies that an "average" function is obtained.

From the initial attempts of Reder [14] and Bronfenbrenner [2] through that of Marschak and Andrews [12] to the most recent literature (Hildebrand and Liu [9]), our theoretical notion of the "average" function and its meaning for the industry and its component firms has not matured appreciably.

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Some econometricians, for instance, seemingly adopt the "average" function as the correct *conceptual* construct with persuasive arguments about "sustained" versus "unusual" output. While such an interpretation has obvious appeal for measurement purposes, the necessary theoretical development which derives from this construct has not been forthcoming. The fact remains that the frontier production function presently forms the core of microeconomic theory, and, in the sense that our marginalism is based on instantaneous, single adjustments rather than persistent ones, appears to be a reasonable goal to pursue empirically.

By applying the techniques of mathematical programming to cross-section data on firms we may produce the envelope function by controlling the disturbance term (in either a single or simultaneous equation setting) to be of one sign only. For a linear programming formulation the objective appears as the sum of such disturbances (a linear loss function), while for quadratic programming the criterion is a minimum for the sum of squared residuals (a quadratic loss function). No presumptions need be made about returns to scale for the industry function, as was necessary in the Farrell work. The empirical assumption required for a programming application is that disturbances are of one sign, i.e., that observed points in the production space lie on or below the frontier only. So long as measurement error may be neglected such a specification can be justified.

However, the estimation potential of these techniques is reduced to some extent by a lack of available statistical inference procedures for use in discriminating between functional forms, among variables, etc. Indeed, our old standbys in classical single-equation regression— $R^2$ ,  $t$ -ratios, and the like—are of little if any use to the model-builder who builds frontiers. Moreover, it is easy to argue that such estimation must be biased in every dimension of the production space, analogous to the sample maximum as an estimator of a population maximum.

This paper, therefore, aims toward a primarily provocative goal. We begin by outlining an empirical framework within which the frontier production function is observable. The empirical problem is then cast into a mathematical programming mold for both single and multiequational settings. Finally, an application—to compare the programming estimates with some work of Hildebrand and Liu [9]—is presented. The concluding remarks focus on implications of the paper for further extensions of the frontier concept, both empirical and theoretical.

### I. *The Industry Production Function*

In microeconomic theory a firm's production function is usually defined in conjunction with a given state of the arts and expresses the *maximum product* obtainable by the firm from a given combination of



factors during the (assumed) short period of time required to produce this output. It is assumed that inputs are applied at some point in time and output appears at some advanced point in time. The notion of continuous production is not considered within the traditional framework, except as it may be approximated by a discrete-time process. In this context, the production function sets the highest possible limit on the output which a firm can hope to obtain with a certain combination of factors at the given state of technical knowledge during the production period. This maximum output applies not only to the particular firm of interest; conceptually it holds for all other firms in the same industry. We might call the function so defined the *industry production function*, to be distinguished from the industry's aggregate production function, which expressed the relationship between aggregate output and the aggregate inputs of that particular industry.

Possibly all and certainly many constituent firm outputs lie below the frontier for a variety of reasons:

1. *Due to pure random shocks in the production process.* For example, some parts of a product may be damaged through careless handling; or, some products are defective, etc.

2. *Due to differences in technical efficiency.* One reason for such differences follows from varied holdings of capital equipment, both in quantity and vintage. Large firms are usually in a better position to replace old equipment than smaller firms, either because of superior self-financing systems or from advantages in obtaining credit terms. And new equipment generally reflects technical improvement. As the composition of capital equipment differs from firm to firm and large firms tend to possess more new equipment, the large firms are generally more efficient. Similarly, there exist efficiency differences in the labor input; for instance, large firms may afford to divert resources to the improvement of labor efficiency while small firms cannot.

3. *Due to differences in economic efficiency.* Given a production function and the market situation, the firm should produce a certain level of output so as to maximize its profits. Such a maximization procedure simultaneously determines the level of output produced and the levels of inputs used. Whenever there is a change in the market situation, the levels of output and inputs must adjust accordingly to assure profit maximization. However, the ability to make such adjustments can hardly be expected to be equal for all firms. Presumably the higher a firm's economic efficiency the higher the level of output that can be achieved for a given input combination.

The technical differences in (2) above are assumed to be manifested in the attained values of technical parameters in the industry production function. Hence, although the individual production functions of

firms are of like form, their technical parameters differ. This realized production function we call the *firm production function*.

In the early interfirm and intrafirm production function discussion, Reder [14] seems to have had these ideas in mind. He first assumed that the production function "is known with complete accuracy, i.e., the values which its parameters take are not affected by random fluctuations" [14, p. 259] and then began to talk about the so-called interfirm production function, which obviously presupposed the existence of differences in the individual firm functions even though the quotation implies that all firms have the same production function. This latter idea is analogous to what we have termed the *industry production function*. The different production functions implied by the concept of the interfirm function are equivalent to what we have called *firm production functions*. Reder's main position seems to have been a justifiable one. However, presumably because of the lag in methodological development which prevented Reder from estimating the industry and firm functions empirically, he remained silent to the criticism of inconsistency leveled against him by Marschak and Andrews [12]. Yet from the above analysis it is clear that actual observations on output should conceptually lie below the true production surface, since had there been any level of output obtained with a given combination of inputs higher than that allowed by the production function, a new state of arts should have been defined.

To date, work in the area of microproduction function estimation assumes that the firm's actual output may either be greater or smaller than the industry production function permits. A group of economists did notice the obvious conflict with theory, however, and some rationalization of this position was attempted.<sup>1</sup> What they did was to assume that the function to be estimated, i.e., the conceptual construct, is an "average" production function for the industry. Some firms could therefore produce more than the average; some, less. But the meaning of such an "average" function is not necessarily clear. Average in the sense of what? a conditional median? a mean? or, a mode?<sup>2</sup> More importantly, average *about* what? about output? about some input? about technology? or about something else? Some economists refer to it as the function for a "firm of average size." This interpretation cannot be correct unless it is assumed that the parameters of the function are random variables and have their expectations equal to those of the firm of "average size." Others seem to refer to the average function as reflecting

<sup>1</sup> See, e.g., Bronfenbrenner [2], Marschak and Andrews [12], and, more recently, Nerlove [13].

<sup>2</sup> For example, in a recent paper, Arthur Goldberger [7] has pointed out the common negligence in interpreting the fitted Cobb-Douglas form as a conditional mean output, when, in fact, it provides the conditional median.

some sort of "average technology." But it would be infeasible to assume that a firm which possesses "average technology" with respect to capital also has an "average technology" with respect to labor. Such a coincidence is even less likely when factors are treated in more definitive categories.

Another appealing interpretation is that "true" productive capacity only makes sense as an output level which can be sustained. The "average" production function, devoid of random fluctuations due to "lucky" coincidences of good weather, sunspots, etc., and "unlucky" ones as well, is thus promoted as the function of sustained output. But the notion of sustained output has long-run overtones which tend to invalidate this argument for the average function in a short-run context. Production processes which depend on uncontrollables like weather as explicit inputs (or catalysts) may be of a different conceptual nature than those of industry, for example, and to the extent that they exist (as in some forms of agricultural production) the frontier concept is unacceptable, but *only* because it assumes inputs to be "variable" in the short run in the sense that the firm may control them.

From a more practical standpoint, if, for example, we wish to estimate how much output *on the average*, could be obtained for a firm in the industry with a certain set of inputs, then the "average" concept would obviously be the correct one to employ. Another very important use of the average function which previously has been overlooked is that in some cases we can approximate the industry's aggregate production function when aggregate data cannot be obtained but data at the firm level are available; or, we can approximate an "average" firm production function when we have data only on industry aggregates. The latter point is especially important because in practice data at the firm level are usually not available. Hildebrand and Liu's [9] belief that observations for some "representative establishments" could be used to estimate U.S. manufacturing production functions is consistent with the first part of the above statement.

Despite these uses for the "average" production function, use of the frontier function is appropriate in order to ascertain the maximum productive capacity of an industry (for purposes of planning, for example), of measuring the potential output of an economy, etc. Along these same lines, M. J. Farrell [5] [6] defined an "efficient production function" which resembles our industry function, and devised an ingenious way of estimating this efficient production function through constructing isoquants. The difficulty with Farrell's method, however, is that it is not general enough. Many types of production cannot be characterized within his models. For example, it is not possible to estimate a produc-

tion function with his method which conforms to the Law of Variable Proportions.

In the following section we attempt to indicate how familiar mathematical programming methods may be used in some cases where Farrell's method would fail to obtain the required production surface. In terms of the generality of approach, while we can alleviate the inherent difficulties of assuming something in advance about the shape of the expansion path, our methods apply only to single output situations.

## II. *Programming Methodology*

To begin, let us consider only the effects of random shocks on the production process; all differences in technical efficiency are subsumed within the disturbance term. Errors of measurement in all variables are also assumed negligible. For simplicity we take a one-output, two-input Cobb-Douglas model over firms.

$$(3.1) \quad x_0 = Ax_1^\alpha x_2^\beta u,$$

with

$$x_0 = \text{output}$$

$$x_1, x_2 = \text{inputs}$$

$$u = \text{random shock}$$

$$A, \alpha, \beta = \text{parameters}$$

Our problem is to obtain an estimated function

$$(3.2) \quad \hat{A} \hat{\alpha} \hat{\beta} x_1 x_2 = \hat{x}_0$$

such that

$$(3.3) \quad \hat{A} \hat{\alpha} \hat{\beta} x_1 x_2 \geq x_0$$

If we take logarithms of both sides of (3.1) and rewrite equations (3.2) and (3.3) compactly in matrix notation, we have:

$$(3.4) \quad X_0 = XC + e$$

$$(3.5) \quad XC \geq X_0,$$

where  $X_0 = \log x_0$ ,  $X_1 = \log x_1$ ,  $X_2 = \log x_2$ ,

$$X = [1 \ X_1 \ X_2]$$

$$C = [A \ \alpha \ \beta]'$$

$e$  = vector of measured residuals

One way to approach the estimation problems imposed by equations (3.4) and (3.5) is to minimize the sum of squared residuals ( $e'e$ ) subject

to (3.5), in which case we formulate the problem as follows, in its form for the general linear production model (positive coefficients on inputs):

To find the positive vector  $C^*$  that minimizes the quadratic function

$$(3.6) \quad e'e = (X\hat{C} - X_0)'(X\hat{C} - X_0) = \hat{C}'X'X\hat{C} - 2\hat{C}'X'X_0 + X_0'X_0$$

subject to:

$$X\hat{C} \geq X_0,$$

(3.6) poses a typical quadratic programming problem and may be solved by Wolfe's algorithm [16].

Since the shocks lie only on one side of the industry production frontier, we may also treat the estimation problem easily within the framework of linear programming. In other words, we may minimize the sum of residuals, as a linear loss function, rather than the sum of squared residuals. The problem may then be written as follows:

To minimize

$$(3.7) \quad l'e = l'(X\hat{C} - X_0), \quad \text{where } l' = [1 \ 1 \ \dots \ 1]$$

subject to:

$$(3.8) \quad \begin{aligned} X\hat{C} &\geq X_0 \\ \hat{C} &\geq 0 \end{aligned}$$

It is to be noted that for some purposes the linear programming estimator may be superior to the quadratic programming estimator since the criterion function is less influenced by extreme values. However, the quadratic programming method provides a convenient treatment when the simultaneous equation model is considered, as we shall see below.

Next, let us attempt to introduce technical efficiency into the model in such a fashion as to make the identification of individual firm functions possible within the context of the industry production function. One way to treat interfirm differences in technical efficiency is to regard them as a part of the disturbance term, as we have above, following Marschak and Andrews [12]. Another approach is adopted by Hildebrand and Liu [9] (hereafter referred to as H-L). These authors attempt to separate the effects of technical efficiency from shocks on theoretical grounds, in an effort to allow only the shocks to influence estimates. The advantage of their method is that (1) if the theoretical specification is correct, then unbiased estimates may be obtained,<sup>4</sup> and (2) individual

<sup>3</sup> Here we would allow the constant term to be of either sign by redefining  $X$  as  $X = [-1 \ 1 \ X_1 \ X_2]$ , and  $C$  as  $C = [A_1 \ A_2 \ \alpha \ \beta]'$ . Then the algorithm is free to select  $A_1$  or  $A_2$  (both positive). If  $A_1$  is chosen ( $A_2=0$ ), the constant term is negative.

<sup>4</sup> Under the assumption  $E(\log u) = 0$ . In a review of the H-L work McFadden [11] demonstrates that their empirical specification is *incorrect*, but that corrections to recover estimates of model structural parameters are available.

firm functions may be derived because technical differences have been specified explicitly.

If we let  $R$  be the ratio of value of equipment to plant, and  $r$  be the ratio of number of technical personnel to production workers, we may use  $R$  and  $r$  as proxy variables for describing the technical level of firms in utilizing the capital and labor inputs, respectively. One Cobb-Douglas production function used by Hildebrand and Liu is

$$(3.9) \quad x_0 = A x_1^{\alpha \log r} x_2^{\beta \log R} u,$$

where  $x_1$  and  $x_2$  represent the labor and capital inputs, respectively.<sup>5</sup> If data on  $R$  and  $r$  can be obtained, estimation may be carried out as described in the previous model. Also, since  $r$  and  $R$  vary over firms, the firm production function can be derived from the industry function by appropriately adjusting these proxy variables.

However, actual output is not only determined by a technical relationship with inputs, it also is affected by an economic adjustment process given some market situation for the procurement of inputs and sale of output. If we assume perfect competition, profit maximization for the firm would yield the following system of simultaneous equations, containing the production function and two derived demand equations for factors, again using the Hildebrand-Liu formulation as a basis for the exposition:

$$(3.10) \quad x_0 = A x_1^{\alpha \log r} x_2^{\beta \log R} u$$

$$(3.11) \quad p_1 x_1 = \alpha (\log r) p_0 x_0 + v_1$$

$$(3.12) \quad p_2 x_2 = \beta (\log R) p_0 x_0 + v_2$$

where

$p_0$  = price of output

$p_1, p_2$  = prices of first and second input, respectively

$$E(v_1) = E(v_2) = 0$$

$$E(v_1 v_1') = \sigma_1^2 I, E(v_2 v_2') = \sigma_2^2 I$$

If we let

$$x_0' = \log x_0$$

$$x_1' = \log r \log x_1$$

<sup>5</sup> McFadden also points out that these proxies for technological differences between firms, as they are used in the Cobb-Douglas function, may not be adequate over the range of input levels on a priori grounds: for instance,  $x_1^{\alpha \log r}$  is not monotonic in  $\log r$  over  $x_1 \geq 0$ , but only over  $x_1 \geq 1$ .

$$x'_2 = \log R \log x_2$$

$$z_1 = (\log r) p_0 x_0$$

$$z_2 = (\log R) p_0 x_0$$

$$y_1 = p_1 x_1$$

$$A' = \log A$$

$$u' = \log u, \text{ with } E(uu') = \sigma_1^2 I$$

$$T = \text{number of observations}$$

then equations (3.10)–(3.12) can be rewritten as:

$$(3.13) \quad W = ZC + U,$$

where

$$\begin{array}{ccccc} \begin{array}{c} \lceil x'_0 \\ W = y_1 \\ \lfloor y_2 \end{array} & Z = \begin{array}{ccc} \begin{array}{c} \cdot 1 \end{array} & \begin{array}{c} x'_1 \end{array} & \begin{array}{c} x'_2 \end{array} \\ 0 & z_1 & 0 \\ 0 & 0 & z_2 \end{array} \lrcorner & C = \begin{array}{c} \lceil A' \rceil \\ \alpha \\ \lfloor \beta \rfloor \end{array} & U = \begin{array}{c} v_1 \\ v_2 \end{array} \end{array}$$

For our purposes the simultaneous setting presents the additional problem of specifying  $\Phi = EUU'$ , the variance-covariance matrix of disturbances, for use in constructing the appropriate quadratic loss function. In Zellner's work [17], for example, the Aitken generalized estimator is used for efficiency purposes. This specification, of a full  $\Phi$  matrix, has no known efficiency properties under the restrictions we impose. Considering the nature of the disturbance  $u'$ ,  $E[(u')(u')'] = \sigma_1^2 I$  has no particular significance for the loss function and also cannot, apparently, be estimated from sample data without specifying  $E(u')$ . Moreover, one can quite reasonably argue for independence of the inputs with output (or value added) in production models of this sort, so that the production function may be considered alone for purposes of estimation.<sup>6</sup>

In light of this discussion, if a simultaneous determination of coefficients is pursued  $\Phi$  must be specified in order to produce the quadratic loss function. Two alternatives seem plausible, but on intuitive grounds only:  $\Phi = I$  (where  $I$  is  $3T \times 3T$ ), and

$$\Phi = \begin{array}{ccc} kI & 0 & 0 \\ 0 & \sigma_2^2 I & 0 \\ 0 & 0 & \sigma_3^2 I \end{array}$$

<sup>6</sup> Cf. Zellner, *et al.* [18, p. 787]. The Zellner paper considers production as stochastic a priori (as contrasted to our deterministic specification), but the key point is specification independent: that the "effect of the disturbance on output cannot be known until after the pre-selected quantities of inputs have been employed in production."

where  $k$  is an arbitrary weighting factor. With  $S$  a sample estimate of  $\frac{1}{k}$  (or  $S=I$ ), our estimation problem is:

To minimize

$$(3.14) \quad U'U = (W - Z\hat{C})'S^{-1}(W - Z\hat{C})$$

subject to

$$X\hat{C} \geq X_0$$

$$\hat{C} \geq 0.$$

As with (3.6), (3.14) should be viewed as being specified for a general linear system of equations.

### III. An Example of Use

To illustrate the use of the programming methods, some empirical results are given here. The production function is version III in Hildebrand and Liu [9; cf., p. 65], as applied to the primary metals industry.<sup>7</sup> The complete model in their notation is as follows:

$$(4.1) \quad \log V = \log A + b_0 \log L + e_0 \log R_{-1} \log K_{-1} + \log u,$$

the production function, and

$$(4.2) \quad \begin{aligned} \log L = & \lambda \log B + (1 - \lambda) \log L_{-1} + (1 - m)\lambda \log V \\ & - (1 - g)\lambda \log W - \lambda \log z \end{aligned}$$

the labor demand function.<sup>8</sup>

Three versions of the programming method are used to produce estimates of the coefficients in (4.1): linear programming (LP) on (4.1), quadratic programming-single equation (QP1) on (4.1), and quadratic programming-simultaneous equation (QP2) on the two equations.<sup>9</sup> The results from such application, together with estimates derived from single equation least squares (1SLS) and two-stage least squares (2SLS) are tabulated below. The data used were for 1957-58, as it was not possible to reproduce perfectly the H-L data for 1956-57. The original H-L results are included in parentheses.

The table is presented in terms of H-L's original empirical work. However, McFadden's criticism that H-L ignored the effects of intermediate good input and the output demand structure on  $b_0$  and  $e_0$  directs us to modify our procedures for computing the last four columns

<sup>7</sup> H-L's data are state aggregates. We use this example for illustrative purposes primarily and ignore the obvious problems of specification and interpretation of the aggregation process on a framework developed for microdata.

<sup>8</sup>  $L$  is labor,  $K_{-1}$  is the lagged (one year) value of capital,  $V$  is value added for output, and  $W$  is the wage rate;  $z$  is a random term and  $\lambda$  is specified as describing the speed of adjustment of the actual demand for labor to its optimal (profit maximizing) value.

<sup>9</sup> In the QP2 results  $S$  was taken to be an identity matrix.



from  $b_0$  and  $e_0$ . We will not, for purposes of this example, recompute all the relevant quantities. However, as an indication of changes in them, corrected estimates for the 2SLS row are:  $h=4.13$ ,  $MPP_L=1.005$ , capital-output elasticity=.021, and technology-output elasticity=.084. In general McFadden's results suggest that H-L's estimates of the scale factor for the two-digit industries considered are high. The conclusion which follows (as contrasted to H-L's) is that no evidence is present which would indicate other than constant returns to scale in these manufacturing industries.

Reviewing the tabled results, the labor-output elasticity ( $b_0$ ) is highest for QP1 (1.071) and lowest for QP2 (.822). It seems that the estimates from all five versions are plausible. The marginal physical product of labor per dollar of wage costs ( $MPP_L$ ) is again highest for QP1 (1.822) and lowest for QP2 (1.399). Following Hildebrand and Liu, the marginal revenue product of labor ( $\phi$ ) is specified at 0.8, which leads to derived estimates of the demand elasticity for output ( $h$ ): ( $h$ ) is

EMPIRICAL RESULTS FOR FIVE ESTIMATION METHODS

	$b_0$ (Labor- Output Elasticity)	$e_0$	$MPP_L$	$h^a$ (Output Demand Elasticity)	Capital- Output Elasticity <sup>b</sup>	Technology- Output Elasticity <sup>b</sup>
1SLS	.908	.0333	1.546	2.072	.1278	.5115
(III.A.1) <sup>c</sup>	(.988)	(.0343) <sup>d</sup>	(1.703)	(1.886)	(.1318)	(.3351)
2SLS	.917	.0321	1.560	2.053	.1232	.4931
(III.A.2) <sup>c</sup>	(1.000)	(.0326) <sup>d</sup>	(1.724)	(1.865)	(.1251)	(.3143)
LP	.873	.0031	1.485	2.168	.0132	.0165
QP1	1.071	.0269	1.822	1.783	.1148	.1441
QP2	.822	.0219	1.399	2.336	.0935	.1173

<sup>a</sup> Marginal revenue product of labor per dollar of wage cost ( $\phi$ ) assumed at 0.8.

<sup>b</sup>  $\ln R_{(\max)}$  used for LP, QP1, QP2;  $\ln \bar{R}$  for 1SLS, 2SLS.

<sup>c</sup> H-L's designation, cf. [9, p. 93].

<sup>d</sup> H-L's results are reported in terms of common log transformations, while we have used the natural system. The base used is immaterial (so long as it is consistently used) in obtaining the coefficient  $b_0$ , but the capital coefficient is affected by the base of the logarithms used. The translation is simple: for the equation fitted in common logarithms, the counterpart of the coefficient  $e_0$  if data is transformed by natural logs is  $e_0' = e_0 \cdot \log_{10} (2.718282) = .434294 e_0$ . Hildebrand and Liu are apparently consistent in their use of common logarithms for the empirical results, but overlook the above scaling problem elsewhere (although it does not seem to cause any invalidation of results). For example [9, p. 50, footnote 8] there is the following:

$$\frac{d}{dR} (e_0 \log R) = \frac{e_0}{R}$$

If  $\log R$  is a common logarithm, as they use in the empirical work, then

$$\frac{d}{dR} (e_0 \log R) = \frac{d}{dR} (e_0 \log_{10} (2.718) \ln R) = \frac{e_0 \log_{10} (2.718)}{R} = \frac{.434294 e_0}{R}$$

largest for QP2 (2.336) and smallest for QP1 (1.783). In view of the nature of this industry, these (indeed, all) values appear to be high, which suggests a smaller value of  $\phi$  should be used.<sup>10</sup>

The significant difference between programming and regression results appears in the capital coefficient and derivatives of it. The capital-output elasticities for LP, QP1, and QP2 are respectively .0132, .1148, and 0.935, while those for one- and two-stage least squares are .1278 and .1232. The technology-output elasticity for LP is .0165; for QP1 and QP2, .1441 and .1173, respectively; for 1SLS and 2SLS, .5115 and .4931.

Using the proxy variable  $R$  as an indicator of technological efficiency within the firms of the primary metals industry, our industry production function (from QP2) would be given by

$$\begin{aligned}(4.3) \quad \ln V &= .8221 \ln L + .0219 \cdot 4.2673 \ln K_{-1} + \text{constant} \\ &= .8221 \ln L + .0935 \ln K_{-1} + \text{constant}\end{aligned}$$

where the maximum value for  $\ln R$  (for the state of Louisiana) is inserted into the general form (4.1). This function would provide the maximum possible output (value added) from the labor and capital inputs given the state of the arts in the industry. Clearly, any individual function (in this case, for a state) may be obtained by substituting the attained value of  $\ln R$  into (4.3).

Without an attempt to identify technological differences among firms explicitly, as with the proxy variables  $r$  and  $R$ , we still may, of course, obtain the industry production function in a simultaneous equation setting. However, individual firm (micro) functions may not be concomitantly estimated.

#### IV. *Final Remarks*

A viable distinction between the average and frontier functions as predictors of capacity (and this is not at all intended to give ground in the theoretical conflict) derives from a probability interpretation of alternative forecasts. On the one hand, the frontier function forecasts an "unlikely" event (output level), whereas the probability attached to the output level given by the average function is higher. A fitted Cobb-Douglas function provides the conditional median output. So 50 per cent of firm outputs for a selected input combination should lie above that output predicted by the fitted Cobb-Douglas function. Of course, these remarks hold in the short run only: The frontier function under a fixed technology gives that output which, in the short run, only a few firms at most can produce for any given input combination (neglecting

<sup>10</sup> The McFadden work suggests that even a wider discrepancy exists in adjusting  $\phi$  so the demand elasticity becomes more "reasonable."

scale differences). Allowing a longer run, as implied by the sustained output idea, but still assuming a fixed technology, more firms presumably become able to produce at the maximum level; under this circumstance, therefore, the frontier function should be the relatively better capacity predictor.

Finally, we have attempted to interpret the traditional theory strictly, in that the frontier we construct is truly a surface of maximum points. Under a different goal one may pursue less than 100 per cent frontiers using the chance-constrained programming ideas of Charnes-Cooper [3], where (3.3) would be translated into a probability statement,  $Pr(\hat{A}x_1^{\hat{\alpha}}x_2^{\hat{\beta}} \geq x_0) \geq T$ , with  $T$  a specified minimum probability with which the statement is to hold.

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## THE RESTRICTIVE EFFECT OF THE U.S. TARIFF AND ITS WELFARE VALUE

By GIORGIO BASEVI\*

The measurement of the effects that international trade distortions have on the welfare of the community has been considerably extended at the theoretical level, and a few important empirical applications have also been attempted in recent years. The theoretical analysis has been developed either in Samuelson's terms of potential welfare, or on less purist but bolder assumptions about constancy of marginal utilities and/or interpersonal comparability of utility. In practice, both types of approaches<sup>1</sup> have used the concept of consumers' surplus for purposes of actual measurement. This study follows the same practical line, leaving to the preference of the reader the choice between alternative sets of assumptions necessary for a consistent theoretical justification of the results.

More important, perhaps, is to survey the development in the degree of sophistication of the models developed for purposes of actual measurement. These have passed through four stages. In the first stage, models were developed at an aggregate level, in which only total imports and total exports were considered. Losses and gains were measured without regard to changes in the terms of trade, thanks to the implicit or explicit assumption of a perfectly elastic foreign-offer curve.<sup>2</sup> A second stage in development was the disaggregation of the analysis and the identification of the effects of restricting each particular import under tariff, including the effects due to the relationships of substitution and complementarity between importable goods.<sup>3</sup> The process of disaggregation, however, stopped short of the inclusion of intermediate products and of the complications introduced by the input-output relationships of actual economic systems. This inclusion—the object of the third stage in the development—was a by-product of the theory of tariff structures. This theory explicitly recognizes that tariffs are levied on both intermediate and final products and that, as a consequence, the

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<sup>1</sup> For an example of the first approach, see [8]; of the second, see [10].

<sup>2</sup> An example of a theoretical study of this type is [4]; for an empirical application, see [12].

<sup>3</sup> An example of a theoretical study of this type is [8]; for an empirical application, see [7].

degree of effective protection on each manufacturing process is given by the net effect that tariffs on inputs (which constitute a tax on the process) and tariff on output (which constitutes a subsidy to the process) have on the value added in the process [9] [2] [1] [3]. As a side question, the problem was also analyzed of how the analysis of the welfare effects of the tariff should be recast in this new framework, and formal theoretical models were developed to this purpose [9] [2].

Although the analysis was pushed to an impressive degree of disaggregation and realism by these latest developments, it still did not take into account the general equilibrium problem of how the two positions to be compared, namely the ones with and without the tariff (structure), are reached. In particular, by not explicitly introducing the possible effect on the terms of trade, the analysis was either crippled by a partial equilibrium approach or confined to a particular case of a perfectly elastic foreign offer curve. The integration of a disaggregated analysis with a general equilibrium one is indeed the fourth stage of the analytical development of the problem, and, as far as I know, has not yet been wholly solved. In my own work [2], a model was presented that tried to integrate the two problems; however, being built for the purpose of actual measurement, it was less a fully developed analytical model than a compromise between statistical practicability and theoretical refinement. In practice, the number of parameters needed for measuring the welfare effects of the tariff structure in a disaggregated and general equilibrium model is so large that no sound econometric work seems to me possible on the basis of the present statistical information and available sectoral studies.

I have therefore aimed, in this study, at a more limited objective. No attempt is made toward disaggregating the measurement of the welfare effects of the tariff into its individual components for each particular good; in this sense the model may seem a return to the first stage in which the problem was posed. On the other hand, both the development in terms of tariff structures and effective rates of protection and the necessity of a general equilibrium analysis are included in the model. The first aspect is reflected in recourse to the concept of the "uniform tariff equivalent" for the purpose of calculating an index of the tariff structure. The second development is included by explicitly setting up a general equilibrium model, capable of incorporating the terms-of-trade effect of the tariff in a concrete monetary environment.

Section I presents the model geometrically, while Section II expresses it in algebraic terms. Section III applies the model to the actual measurement of the welfare effects of the U.S. tariff structure in the years 1959-62. Section IV contains the interpretation of the results and a summary of the study.

I. *The Model: Geometrical Presentation*

Before treating the problem algebraically, it might be useful to present it geometrically, for this helps in understanding a process of expansion of imports consequent to the elimination of the tariff that is balanced by an equal expansion of exports, and in understanding the welfare effects of the tariff when this adjustment is taken into account.<sup>4</sup>

This is shown in Figure 1. Both sides of the figure have units on the

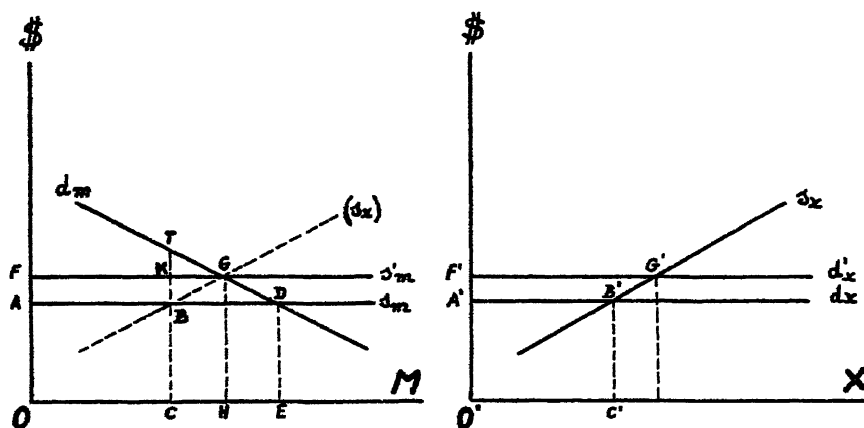


FIGURE 1

vertical axes expressed in domestic currency; on the left-hand side, the horizontal axis measures quantities of imports; on the right-hand side, quantities of exports. With a tariff on imports at a rate  $t_n = TB/BC$ , the foreign value of imports in terms of domestic currency is the area  $OABC$ , and it is equal to the area  $O'A'B'C'$ , which is the value of exports also measured in domestic currency.

When the tariff is eliminated, the first reaction would be an increase of imports up to a value equal to the area  $OADE$ ; but this turns the balance of trade into a deficit (equal to  $CBDE$ ). The equilibrating adjustment is assumed to take place through the exchange rate;<sup>5</sup> this means that, if the conditions for a devaluation improving the balance of trade are met, elimination of the tariff causes a depreciation of the domestic currency in terms of the foreign currency. This is shown in

<sup>4</sup> The following analysis is conducted mainly in terms of the effects of eliminating the tariff. The conclusions, however, are altered only formally if we consider the reverse process of imposing the tariff, and its effects.

<sup>5</sup> Alternatively, it could be assumed that the adjustment works through inflation and deflation of wages and prices in the two countries (the home country and the rest of the world); this would not change the geometrical analysis, but it would formally alter its algebraic expression.

Figure 1 by an upward shift of both the supply of imports (from  $s_m$  to  $s_m'$ ) and the demand for exports (from  $d_x$  to  $d_x'$ ). The shift, i.e., the change in the exchange rate, is such that in the new position the value of imports ( $OFGH$ ) is again equal to the value of exports ( $O'F'G'H'$ ).

Under normal conditions the tariff improves the terms of trade of the home country, unless the offer curve of the rest of the world is perfectly elastic. In order to measure the welfare effects of the tariff in this model, it is useful to consider four possible cases, in which: (1) the home country cannot influence the price of either its imports or exports; (2) the home country can influence the price of its imports but not exports; (3) the home country can influence the price of its exports but not imports; and (4) the home country has some control on the prices of both imports and exports.

The first case is the one represented in Figure 1, where both the supply of imports and the demand for exports are perfectly elastic at the given world price. Since in this case the tariff does not improve the terms of trade of the home country—in fact the offer curve of the rest of the world is perfectly elastic—there is no way in which welfare can be increased by the restriction of trade. Thus, the net effect of the tariff has to be a cost. One way of identifying this net loss is to consider that the increase in the quantity of imports, owing to the elimination of the tariff, brings about an increase in import consumers' utility equal to  $CTGH$ ; but in order to gain this utility, the community has to sell additional exports worth  $C'B'G'H'$ . Thus the net effect of the tariff is equal to

$$W = CTGH - C'B'G'H'.^6$$

The second case, where the supply of imports is less than perfectly elastic while the price of exports is still assumed to be outside the control of the home country, gives rise to welfare effects whose measurement is analogous to that portrayed in Figure 1; except that now, be-

<sup>6</sup> By addition and subtraction of areas, this measure can be converted into an equivalent one, which is capable of a different economic interpretation. In fact,  $W = KTG + (CKGH + AFKB) - AFKB - (C'B'G'H' + A'F'G'B') + A'F'G'B'$ . But the two parenthetical terms are equal to each other, being the difference between the two equilibrium levels of imports and exports, respectively; thus  $W = KTG - AFKB + A'F'G'B'$ . This second equivalent measure of the effects of the tariff may be interpreted as the algebraic sum of a net consumers' utility loss ( $KTG$ ), a net revenue gain ( $AFKB$ ) due to the fact that part of the tariff is paid by foreign exporters through a lower value of their exports, and a loss in producers' surplus ( $A'F'G'B'$ ). In this case, in which the tariff has no terms-of-trade effect, an alternative formulation can be given to the two equivalent measures derived above. It can easily be shown that, in this case,  $CBGH$  is equal to  $C'B'G'H'$ . Thus  $W = CTGH - CBGH = BTG$ , which is necessarily a loss. Because in this case the terms of trade do not change, the supply curve of exports can be drawn against the demand curve for imports (as shown by the dotted ( $s_x$ ) line in the lefthand side of Figure 1) as it would be in a model in which prices of imports are measured in terms of exports, i.e., relative instead of monetary prices. The welfare loss  $BTG$  is then clearly seen as the net utility lost by consumers because of the restriction of trade.



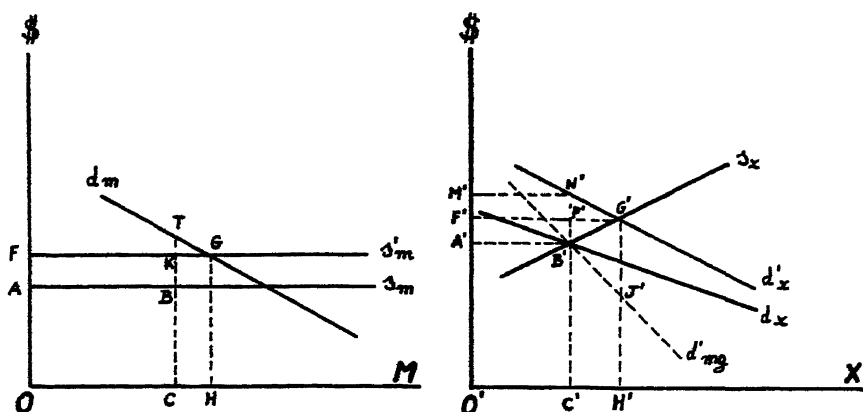


FIGURE 2

cause of the existence of a terms-of-trade effect, the net welfare effect of the restriction of trade may turn out to be a gain.

The third case is represented in Figure 2, where the demand for exports is less than perfectly elastic, while the price of imports is now outside the control of the home country. As in the two preceding cases, the welfare effect of the tariff can alternatively be measured as

$$W = CTGH - C'B'G'H'$$

or

$$= KTG - AFKB + A'F'G'B'.$$

As in the second case, the tariff improves the terms of trade and, if not set too high, also the welfare of the home country. Although it is the money price of exports that can be affected by the restriction of trade, the tariff is assumed to be raised on the import side,  $t_m = TB/BC$ . Because of the symmetry between export and import taxes, this does not really matter. Indeed, in the example of Figure 2, the tariff is levied at the optimum level; in fact, if trade were freed, the value of the currency would depreciate up to a point at which the marginal revenue obtained from the amount exported under the tariff would be equal to its marginal cost. This is shown in the figure by the fact that the curve marginal to the new demand for exports ( $d'_{m_g}$ ) intersects the supply of exports (at  $B'$ ) at the price for which they sell when trade is restricted by the tariff.<sup>7</sup>

<sup>7</sup> Thus, the welfare effects of the tariff can also be measured in terms of marginal curves and shown to be equivalent to the two measures proposed above. In fact, the area  $B'G'J'$ , being the integral of the difference between the marginal cost and the marginal revenue from the

The fourth case, when both the supply of imports and the demand for exports are less than perfectly elastic, does not present any new element in the geometrical treatment of the welfare effects of trade restriction. A tariff improves the terms of trade of the home country and, provided it is not too high, adds to the welfare of its residents. The equivalence between the various ways of measuring this effect can again be shown, but nothing is gained in repeating an argument logically not different from the one developed in the preceding cases. Thus, choosing the first method of measuring the welfare effects, we shall have a loss in consumers' utility due to the restriction of imports (analogous to the area  $CTGH$  in Figures 1 and 2) minus a gain in resources freed from buying that utility (analogous to the area  $C'B'G'H'$  in the same figures).<sup>8</sup> Algebraically, these two elements are respectively equivalent to

$$(1) \quad W_m = - [(p_m + T_m) + \frac{1}{2}d(p_m + T_m)]dM$$

and

$$(2) \quad W_x = (p_x + \frac{1}{2}dp_x)dX$$

where  $M$  and  $X$  are the volumes of imports and exports,  $p_m$  and  $p_x$  their prices, both expressed in domestic currency, and  $T_m$  is the unit tariff. Thus  $W = W_x + W_m$  is the total welfare effect of protection, defined as positive if it is a net gain and negative if it is a net loss.

## II. Rate of Devaluation Implicit in the Tariff

In order to measure the welfare effects presented geometrically in the preceding section, it is necessary to derive an expression for the change in exchange rate due to the elimination of the tariff. The simplest method is to start from the balance of trade equality, finding its differential, setting it equal to zero and solving for the differential of the

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additional exports, represents a gain from the restriction of trade. Moreover, on the import side the area  $KTG$  represents a cost, being the integral of the difference between the marginal value and the marginal cost of the additional imports. Thus  $W = KTG - C'B'G'H' + B'J'H'C' = KTG - C'B'G'H' + (O'F'G'H' - O'M'N'C') = KTG + B'P'G' - F'M'N'P'$  which, since the increased value of the initial volume of imports due to depreciation ( $FKBA$ ) is equal to the increased value of the initial volume of exports ( $A'M'N'B'$ ), is equal to  $KTG - AFKB + A'F'G'B'$ , which is one of the two equivalent measures of the welfare effects proposed before.

<sup>8</sup> For the sake of precision, it should be noted that the latter gain is totally due to the value of resources freed from export industries only when exportable goods are not also domestically consumed; if, on the contrary, they are also domestically consumed, this gain is partly a resource-saving and partly a direct utility gain due to the lower prices of exportable goods that must be paid by domestic consumers when the tariff restricts trade. Similarly, when importable goods are also domestically produced, the welfare loss on imports foregone is partly due to a loss in direct consumers' utility and partly to the inefficient use of resources in producing additional import substitutes.

exchange rate. This yields an approximation to the change in the exchange rate that will bring the balance of trade back to equilibrium.<sup>9</sup>

$$(3) \quad dB = p_x dX + X dp_x - p_m dM - M dp_m$$

where  $B$  is the balance of trade in domestic currency. The differential of exports can be expressed both in terms of the slope of the supply of exports and the slope of the demand for exports, i.e.,

$$(4) \quad dX = \alpha dp_x = \beta d\pi_x$$

where  $\alpha = \partial X / \partial p_x$  is the supply slope of exports,  $\beta = \partial X / \partial \pi_x$  is the demand slope for exports, and  $\pi_x$  is the price of exports in foreign currency such that  $p_x / \pi_x = r$  is the rate of exchange between domestic and foreign currency.

Choosing units such that domestic prices and the rate of exchange are initially equal to unity, we have

$$(5) \quad d\pi_x = dp_x - \dot{r}$$

where  $\dot{r}$  is the proportional change in the rate of exchange. Substituting (5) into (4) and solving for  $dp_x$ ,

$$(6) \quad dp_x = \frac{\beta}{\alpha} \dot{r}$$

Similarly, the differential of imports can be expressed as

$$(7) \quad dM = \gamma d(p_m + T_m) = \delta d\pi_m$$

where  $\alpha = \partial M / \partial p_m$  is the slope of the demand for imports and  $\delta = \partial M / \partial \pi_m$  is the slope of the supply of imports. As for  $d\pi_m$ ,

$$(8) \quad d\pi_m = dp_m - \dot{r}$$

and

$$(9) \quad d(p_m + T_m) = dp_m - T_m$$

because in this model the change of the tariff is equal to its total elimination. Substituting (8) and (9) into (7) and solving for  $dp_m$ ,

$$(10) \quad dp_m = \frac{\gamma T_m - \delta \dot{r}}{\gamma - \delta}$$

After having collected terms and substituted (6), (7), (9) and (10) into (3), we solve for  $\dot{r}$  by letting  $dB = 0$ . Writing elasticities instead of slopes

<sup>9</sup> This assumes that the balance on capital account is fixed in terms of domestic currency. For a country like the United States, whose capital outflow is much larger than the inflow, the assumption seems to be sufficiently realistic.

the result is<sup>10</sup>

$$(11) \quad \dot{r} = \frac{\eta_m(\epsilon_m + 1)t_m}{\frac{X}{M}(\epsilon_x + 1) \frac{\eta_x}{\eta_x - \epsilon_x} [\eta_m - \epsilon_m(1 + t_m)] + \epsilon_m(\eta_m + 1 + t_m)}$$

where the elasticities of demand ( $\eta_x, \eta_m$ ) are defined as negative and the elasticities of supply ( $\epsilon_x, \epsilon_m$ ) as positive.

Because of the choice of units,  $X$  and  $M$  represent values of exports and imports when trade is restricted by the tariff; the factor  $X/M$ , which is unity when the balance of trade is zero, becomes a correction factor when the equilibrium of the balance of payments implies a deficit or a surplus in the balance of trade.

The fact that equation (11) resembles closely the formulae developed by various authors in connection with the "elasticity approach" to devaluation, should not lead us into thinking that it suffers from the same defects. Indeed, the basic criticism made of the elasticity approach, namely that either it is a partial equilibrium approach or it conceals under its "total" elasticities all kinds of underlying income adjustments, does not apply to equation (11). In this model, in fact, since we are estimating the welfare effect of the tariff, it is explicitly assumed that the real income of the community is maintained constant (except for the gain or loss that we are measuring) by an appropriate government policy. This means, in particular, that the elimination of the tariff would call for the introduction of a tax (a set of taxes) which gives the same revenue, does not introduce distortions in the allocation of resources, and has an overall incidence similar to that of the tariff structure. In our model the devaluation simply replaces the equivalent (in terms of trade restriction) tariff and there is no change in income and absorption to be considered, except what results from the efficiency and terms of trade effects that we are measuring.

Analysis of equation (11) reveals interesting facts about the change in the exchange rate,  $\dot{r}$ , and its relationship to the parameters appearing in the equation:

(a) the change in the exchange rate is normally positive, implying a depreciation of the domestic currency if the tariff were eliminated. In fact, when imports equal exports in equilibrium, it can be shown that the necessary condition for  $\dot{r}$  to be positive is the so-called Marshall-Lerner stability condition, i.e.,  $|\eta_x + \eta_m| > 1$ ; moreover, a sufficient condition for a positive  $\dot{r}$  is that the elasticity of demand for exports not be smaller than unity in absolute value, and this condition is very likely to be satisfied for any country with diversified exports.

<sup>10</sup> Note that, since  $p_m = 1$ , the unit tariff  $T_m$  is equal to the rate of tariff  $t_m$ .

(b) Equally interesting is the case in which  $\dot{r} > t_m$ , i.e., when the improvement of the terms of trade obtained with the tariff is so high that the price of imports to domestic consumers would rise, instead of fall, after eliminating the tariff. Assuming again that exports equal imports at equilibrium, it can be shown that the above-mentioned sufficient condition for a positive change in the rate of exchange ( $|\eta_x| > 1$ ) is also sufficient condition for it to be no larger than  $t_m$ . We can therefore conclude that normally elimination of the tariff would lead to devaluation and the percentage devaluation would be less than the percentage tariff. Both conclusions were indeed to be expected, since it is well known that devaluation in a stable system has the same effect on the balance of trade as a general tax on imports plus a general subsidy to exports, applied at the same rate as the devaluation.

(c) It is also interesting to examine how  $\dot{r}$  changes when the parameters on which it depends take different values. Assuming that these parameters are independent of each other, the following relations can be verified for the normal range in which  $\dot{r}$  is positive and smaller than  $t_m$ :  $\dot{r}$  grows larger with  $t_m$ ,  $\epsilon_m$ , and  $|\eta_m|$ , while it is smaller the larger are  $\epsilon_x$  and  $|\eta_x|$ .

The expression for  $\dot{r}$  should now be introduced into the measurement of the welfare effects of the tariff analyzed in Section I. Thus, making use of the relationships developed in the course of deriving (11), we can write (1) and (2) as

$$(1') \quad W_m = -M \frac{\eta_m \epsilon_m (t_m - \dot{r})}{\eta_m - \epsilon_m (1 + t_m)} \cdot \left[ 1 + \frac{1}{2} \left( \dot{r} + t_m + \frac{\eta_m (t_m - \dot{r})}{\eta_m - \epsilon_m (1 + t_m)} \right) \right]$$

$$(2') \quad W_x = X \epsilon_x \frac{\eta_x}{\eta_x - \epsilon_x} \dot{r} \left( 1 + \frac{1}{2} \frac{\eta_x}{\eta_x - \epsilon_x} \dot{r} \right)$$

However, the value of  $\dot{r}$  given by equation (11) is an approximation, derived by taking differentials and neglecting products of two differentials,  $dXd p_x$  and  $dMd p_m$ . These two products are the essence of (1) and (2); thus it is illegitimate to use the value of  $\dot{r}$  given by equation (11) in order to calculate (1') and (2'). The computations of the next section, therefore, are based on values of  $\dot{r}$  obtained from the solution of the equation which replaces (3) when the products  $dXd p_x$  and  $dMd p_m$  are not neglected.<sup>11</sup>

<sup>11</sup> This is a quadratic equation in  $\dot{r}$  whose roots are calculated in the next section, once the numerical values of the parameters are given, but cannot easily be reduced to an analytical form like equation (11). On the other hand, computations of  $\dot{r}$  carried out on the basis of (11) show that this equation results in very good approximations to the values of  $\dot{r}$  obtained from

### III. *Estimates*

The measurement of the welfare value of the restrictive effect of the tariff on the basis of the formulae developed above is applied in this section to the United States. For this purpose we need estimates of the elasticities of demand and supply of total U.S. exports and imports, values of exports and imports, and an index  $t_m$  of the level of the U.S. tariff.

As for the elasticities, the available information is not very satisfactory and often completely lacking. Most of the existing statistical estimates of demand elasticities for imports and exports are subject to severe downward bias, and estimates of elasticities of supply of exports and imports are practically nonexistent. In a study on the overvaluation of the dollar [6], John E. Floyd has integrated available estimates with values derived from a priori reasoning, by making particular use of the fact that more reliable information exists on the underlying domestic demand and supply elasticities of traded goods. The elasticities necessary for analyzing the problem of the overvaluation of the dollar in the framework of Floyd's model are the same as those necessary for our problem; in particular, these elasticities are evaluated at constant aggregate demand. Floyd obtains definite estimates for the supply elasticities of exports and imports ( $\epsilon_x = 4.5$ ;  $\epsilon_m = 6.1$ ), while for each of the demand elasticities a high ( $\eta_x = -9.9$ ;  $\eta_m = -2.7$ ) and a low ( $\eta_x = -5.1$ ;  $\eta_m = -1.5$ ) estimate is given under the alternative assumptions of perfect and imperfect substitutability between U.S. goods and their foreign counterparts. In the present study, the calculations are performed on the basis of all four possible sets of elasticities that result from these alternative assumptions. The estimates are averages for the period 1958-62.

As for the amount of trade, I have taken the f.o.b. value of merchandise exports and imports, net of military transactions; the averages for the same period were \$19,107 million and \$15,076 million respectively.

The last parameter necessary for our measurement is an index of the U.S. tariff structure. The relevant concept for this purpose was developed in connection with the theory of effective protection and named by Corden the "uniform tariff equivalent."<sup>12</sup> This is the tariff rate that would yield the same restriction of imports as the actual tariff structure, if it were applied uniformly to all importable goods (including those that are not subject to tariff in the actual situation).

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the positive roots of the quadratic equations. I am indebted to the referee for pointing out to me the logical necessity of considering the products of differentials in the derivation of  $t$  for the purpose of measuring welfare changes.

<sup>12</sup> Corden's idea has been developed by H. G. Johnson in connection with [2]; Balassa has further developed the concept in [1].

TABLE I—ESTIMATES OF THE WELFARE EFFECTS OF THE U.S. TARIFF  
(in \$ million for the average 1958-62)

Tariff Rate (per cent)	Elasticities				Implicit Depreciation (per cent)	Loss on Imports $W_m$	Gain on Exports $W_x$	Net Welfare Effect $W$
	$\eta_m$	$\epsilon_m$	$\eta_x$	$\epsilon_x$				
13	-1.5	6.1	-9.9	4.5	3.31	-1737	+1977	+240
	-1.5	6.1	-5.1	4.5	4.22	-1579	+1949	+370
	-2.7	6.1	-9.9	4.5	4.56	-2401	+2739	+338
	-2.7	6.1	-5.1	4.5	5.62	-2107	+2608	+501
15	-1.5	6.1	-9.9	4.5	3.78	-2006	+2264	+258
	-1.5	6.1	-5.1	4.5	4.83	-1825	+2236	+411
	-2.7	6.1	-9.9	4.5	5.23	-2782	+3149	+367
	-2.7	6.1	-5.1	4.5	6.46	-2443	+3001	+558
17	-1.5	6.1	-9.9	4.5	4.25	-2276	+2548	+272
	-1.5	6.1	-5.1	4.5	5.44	-2073	+2519	+446
	-2.7	6.1	-9.9	4.5	5.90	-3166	+3556	+390
	-2.7	6.1	-5.1	4.5	7.29	-2782	+3392	+610

Estimates of the "uniform tariff equivalent" are subject to a high degree of guesswork. It is, however, reassuring to find that, although working along different lines and drawing upon different sources of data, the Balassa estimates and mine come very close together [1] [2]. Considering tariffs on all importable products I estimated a uniform tariff of about 15 per cent for the years 1959-60; Balassa, on the other hand, on the basis of manufactured products only (on which tariffs and effective rates of protection are generally higher) gives an estimate of 16.7 per cent for 1962, i.e., for the tariff structure as it resulted after the Dillon Round of tariff negotiations.

In the measurement of the welfare effects below I have therefore kept a 15 per cent uniform tariff equivalent as a good index of the U.S. tariff structure as it stood in the average of the years 1958-1962, and for comparison I have shown the effects of a 13 and a 17 per cent tariff. Table 1 presents the empirical results of this study.

As by-product of this measurement, it is interesting to note the values of the depreciation implicit in the U.S. tariff structure. These range from 3.78 to 6.46 per cent, depending on the estimates of the elasticities,

meaning that if the U.S. tariff around 1960 had been eliminated unilaterally, the same volume of trade and balance of payments at constant incomes could have been maintained through a depreciation of the exchange rate by that percentage.

As for the measure of the net welfare effect of the tariff ( $W$ ), it turns out to be a gain under all alternative sets of elasticities, the value ranging from \$258 to \$558 million. The gains are larger in cases where the monopolistic position of the United States in the sale of its exports is stronger (cases of low elasticities of demand for exports); while they are lower in the opposite cases. The lower the elasticity of U.S. demand for imports, the less the United States is able to exploit its monopsonistic position on the import side and the lower is the net overall gain for a given set of the other elasticities.

#### IV. Conclusions

The only other estimate of the welfare effect of the U.S. tariff is, to my knowledge, the one obtained by Robert Stern for the year 1960 [11]. Stern used a somewhat disaggregated model, did not take into account the interplay of the tariff structure with the input-output relationships of the economy, nor did he correct his estimates for the general equilibrium terms of trade effect of the tariff. Because of this second limitation, his results are bound to show an efficiency loss due to the tariff, which he estimated at a value ranging from \$258 to \$448 million in 1960.

The present study, on the other hand, has explicitly introduced the terms-of-trade effect of the tariff in a general equilibrium model. The result is that the efficiency loss of the tariff, a much higher estimate than Stern's, turns out to be more than compensated by the value of the improvement in the terms of trade. The net welfare value of the restrictive effect of the tariff is estimated at a gain ranging from \$258 to \$558 million.

These magnitudes are very small, representing at most 0.11 per cent of national income; thus not much change in welfare is to be expected in the United States from a unilateral reduction of tariffs. However, tariffs in the rest of the world involve a terms-of-trade loss for the United States; reciprocal elimination of tariffs, therefore, would involve a net terms-of-trade effect which could be either positive or negative, but still very small.

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# COMMUNICATIONS

## Distilled Spirits and Interstate Consumption Effects

The distribution and sale of distilled spirits is under direct government control in 16 states and under private control in the others. The governmental markup procedure differs widely for the control (or monopoly) states while for the private (or license) states the average state tax rate ranges from approximately \$.75 to \$3.25 per gallon. This leads to large differences among states in the price of distilled spirits. The existence of such price differentials together with the fact that (at least small quantities of) distilled spirits are easily transportable suggests that part of observed liquor sales in low-priced states may be to residents of other states. The purpose of this paper is to estimate the extent of such interstate liquor traffic. The following (cross sectional) econometric model will be used in analyzing consumption patterns of distilled spirits.

### I. *Econometric Model*

Let

- $C_j$  = sales of distilled spirits in  $j$  (state  $j$ )
- $C_{jj}$  = sales of spirits in  $j$  to residents of  $j$
- $C_{mj}$  = sales of spirits in  $j$  to residents of  $m$
- $w_{jj}$  = number of residents of  $j$  buying spirits in  $j$
- $w_{mj}$  = number of residents of  $m$  buying spirits in  $j$
- $w_j$  = adult population of  $j$  (persons over 21)
- $p_j$  = average price of spirits in  $j$
- $c_{jj} = C_{jj}/w_{jj}$  = average consumption of spirits by residents of  $j$  who buy in  $j$
- $c_{mj} = C_{mj}/w_{mj}$  = average consumption of spirits by residents of  $m$  who buy in  $j$
- $c_j = C_j/w_j$  = observed per adult sales in  $j$

The basic assumption underlying the analysis is that the average level of consumption of distilled spirits in every state can be approximated by a linear relation between the price of spirits and the average level of disposable income. This requirement that consumption habits be the same in all states, although unrealistic when applied to a particular classification of liquor such as blended whiskey, straight whiskey, gin, or rum, is probably not unreasonable when applied to the classification of all spirits.<sup>1</sup> Further it is assumed that an individual will always purchase spirits at the lowest price available to him, either in his own or in a neighboring state, and hence

<sup>1</sup>Although the terms distilled spirits and liquor will be used interchangeably in this paper to mean distilled beverages, it should be realized that in general usage the liquor classification is broader, including fermented products such as wine and beer as well as products which are actually distilled.

will never purchase distilled spirits in more than one state. (This restriction will be relaxed shortly.) These assumptions are expressed in the following relations:

$$(1) \quad c_{jj} = a_0 + a_1 y_j + a_2 p_j + e_{jj}$$

$$(2) \quad c_{mj} = a_0 + a_1 y_m + a_2 p_{m,j} + e_{mj}$$

where (1) holds for all states  $j$  and (2) holds for all states  $j$  and neighbor states  $m$  in which  $p_m > p_j$ . Further,  $e$  is the disturbance term, and  $p_{m,j}$  is the average price paid by residents of  $m$  buying in  $j$ , and therefore depends on  $p_m$  and  $p_j$  (in a manner to be determined shortly). The inclusion of  $y$  in the equations assumes that the average level of disposable income for the group that purchases spirits within the state is the same as that for the groups that buy in other states. Equations (1) and (2) cannot be estimated directly since  $c_{jj}$  and  $c_{mj}$  are not observable. What is required is a method of determining the extent to which the residents of each state purchase liquor in neighboring states.

Assume that the price of spirits is lower in  $k$  than  $j$ . An individual in state  $j$  will buy in  $k$  only if the price in  $k$  plus the transportation cost involved is less than the price in  $j$ . Let  $g$  be the cost per mile of transporting spirits between states. Then the cost is the same in  $j$  and  $k$  for an individual in  $j$  located at a distance  $d^*_{jk}$  from  $k$  if  $d^*_{jk}$  is given by:<sup>2</sup>

$$(3) \quad d^*_{jk} = (p_j - p_k)/g.$$

Therefore the area in  $j$  from which it is less expensive to buy liquor in  $k$  than  $j$  can be approximated by the rectangle  $d^*_{jk} B_{jk}$ , where  $B_{jk}$  is the length of the common border between  $j$  and  $k$ .<sup>3</sup> A study of the geography of the states suggests that this is a reasonable approximation for most states. It is of course only an approximation since in particular it assumes away problems of the existence of liquor outlets and roads, and since in general the true area will not be given by a rectangle. Further it is possible that an out-of-state liquor purchase may be made in a nonbordering state, but probably the only relevant case is that of Utah, Arizona, New Mexico and Colorado meeting at a point, so that the length of their common border is zero.

In order to determine the volume of interstate liquor traffic it is necessary to know the population of the area  $B_{jk} d^*_{jk}$ , that is, the area from which it is

<sup>2</sup> Two points should be made. First the parameter  $g$  must be interpreted with care. In the expression given above it represents the cost per mile *per fifth* of transporting spirits. But since the actual cost will probably be independent of volume it is necessary to interpret  $g$  in terms of an average quantity purchased per trip. This is probably not unrealistic in view of the fact that large purchases (say of 15 or 20 fifths) will tend to be avoided because of the risk involved in drawing attention to the buyer. On the other hand very small purchases will be unprofitable. Second, the model appears to require that residents in  $j$  located  $d^*_{jk}$  miles from  $k$  will buy in  $k$  even though there is no monetary advantage in doing so. This need not be the case, however, since the possibility that individuals will insist on a certain minimum net gain can be taken into account by assuming that the parameter  $g$  includes such an amount. The gain is larger of course for individuals living closer than  $d^*_{jk}$  miles to  $k$ .

<sup>3</sup> The illegality of mailing distilled spirits from one state to another rules out the possibility that spirits might move more cheaply by this means.

cheaper for residents of  $j$  to buy in  $k$ . An estimate may be obtained as follows. Consider all counties in  $j$  which lie entirely or partially within a given distance, say 50 miles, of  $k$ . Let the total area of these counties be  $A_{jk}$  and the corresponding adult population  $v_{jk}$ . Assume further that the latter is uniformly distributed over the area of the counties. Then the fraction of the population of these counties which finds it cheaper to buy in  $k$  is equal to the ratio of the area  $B_{jk}d^*_{jk}$  to the total area of the counties, that is:

$$(4) \quad w_{jk}/v_{jk} = B_{jk}d^*_{jk}/A_{jk} = B_{jk}(p_j - p_k)/(A_{jk}g)$$

where (4) holds for all states  $j$  and neighbors  $k$  in which

$$p_k < p_j, \text{ while } w_{jk}/v_{jk} = 0 \text{ if } p_k \geq p_j.$$

The assumption of 50 miles is of course arbitrary, and is intended to represent an upper bound to the distance an individual will travel in order to buy distilled spirits in a neighboring state. In reality this bound will depend on the price differential between states, but since the cost of transporting liquor is unknown the distance cannot be determined exactly. If a very large bound is chosen then the assumption of a uniform population distribution within the area is likely to be very unrealistic. The extreme case of this is to assume that the population is distributed uniformly over the entire state. On the other hand if too small a bound is chosen then some interstate liquor purchases are being ignored. In choosing the counties to be included in the analysis this bound was varied at the author's discretion (from approximately 25 to 100 miles) but in most cases a value of 50 was used.<sup>4</sup>

There are a number of reasons why some residents of  $j$  may choose to buy in  $j$  rather than  $k$  even if it is more expensive to do so. First the fact that out-of-state purchases are generally illegal may dissuade many potential buyers.<sup>5</sup> Second some individuals may dislike to plan very far in advance or may be financially unable to do so in which case out-of-state trips will not be profitable, and reliance will be placed instead on frequent trips to the corner liquor store. Further, even for those who generally plan ahead and buy in a neighboring state, there will probably be instances when it is con-

<sup>4</sup> It seems unlikely in general that a (return) trip of more than 100 miles will be undertaken. If the imputed cost of running an automobile is 10¢ per mile for example, then the total cost of a 100 mile trip, excluding the opportunity cost of the time spent, is \$10.00. In order to break even on such a trip purchases of 40, 20 and 10 fifths would be required if the price differential between states were \$.25, .50 and 1.00 respectively. Although a purchase of 10 or perhaps even 20 fifths does not seem unreasonable, larger quantities will probably tend to be avoided because of the possibility that they may draw attention to the purchaser. Since price differentials are very large in only a few instances it seems likely that round trips of over 100 miles will not generally be undertaken. This will certainly be the case if the cost of the travel time is included or if the individual requires a net gain on his purchases. Nevertheless as mentioned above a bound of more than 50 miles was used for large price differentials.

<sup>5</sup> Laws concerning the quantity of distilled spirits which may be imported for personal use vary considerably across states. Excluding Hawaii and Alaska 28 states permit no such liquor imports, 5 permit 1 quart, and 10 permit 1 gallon to be imported. Laws for the 5 remaining states cannot be summarized readily but details concerning the laws are available in [4].

venient to buy within the state. Finally suitable transportation facilities may be unavailable thus making it impossible to purchase in another state.

For these reasons it is assumed that the relevant population ratio is only *proportional* to the area ratio, and that this relation holds subject to a random disturbance term  $u$ . That is, it is assumed that if there is an aversion to buying, or inability to buy in neighboring states, then it exists essentially to the same degree in all states. Combining the proportionality factor with the unknown  $g$  value and denoting it by  $b$  gives, for each state  $j$ :

$$(5) \quad w_{mj}/v_{mj} = bB_{mj}(p_m - p_j)/A_{mj} + u_{mj}$$

$$(6) \quad w_{jj} = w_j - \sum_k w_{jk}$$

where (5) holds for neighbor states  $m$  in which  $p_m \geq p_j$  and the summation in (6) is over neighbor states with  $p_k < p_j$ . Under these assumptions the average price paid by individuals in  $m$  buying in  $j$  ( $p_{m,j}$ ) can be calculated to be the arithmetic mean of the two prices.

The only consumption values which are observable are the sales of spirits in each state, that is,  $C_j$ . But these sales are made to residents of  $j$ , and to residents of neighboring states where the price of distilled spirits is greater than in  $j$ , and therefore  $C_j = C_{jj} + \sum_m C_{mj}$ . The latter expression may be written in terms of the variables in equations 1-6 in the following manner (ignoring the disturbance terms):

$$(7) \quad C_j = (a_0 + a_1 y_j + a_2 p_j) w_{jj} + \sum_m (a_0 + a_1 y_m + a_2 p_{m,j}) w_{mj} \\ = (a_0 + a_1 y_j + a_2 p_j) \left( w_j - b \sum_k B_{jk} (p_j - p_k) v_{jk} / A_{jk} \right) \\ + \sum_m (a_0 + a_1 y_m + a_2 p_{m,j}) (b v_{mj} B_{mj} (p_m - p_j) / A_{mj})$$

where the  $a$ 's and the  $b$  are the parameters to be estimated. Rearranging terms, and dividing by  $w_j$  in order to avoid obscuring the relation with the strong association between total consumption and population, and also probably reducing the heteroskedacity of the error term, yields:

$$(8) \quad c_j = a_0 \left( 1 - b \sum_k z_{jk} + b \sum_m x_{mj} \right) \\ + a_1 \left( y_j - b \sum_k z_{jk} y_j + b \sum_m x_{mj} y_m \right) \\ + a_2 \left( p_j - b \sum_k z_{jk} p_j + b \sum_m x_{mj} p_{j,m} \right)$$

where:

$$z_{jk} = B_{jk} v_{jk} (p_j - p_k) / (A_{jk} w_j) \quad \text{and} \quad x_{mj} = B_{mj} v_{mj} (p_m - p_j) / (A_{mj} w_j).$$

For fixed values of  $b$ , estimates of the  $a$ 's can be obtained by least squares. Hence if narrow bounds on  $b$  are known, a priori, then the equation can be estimated for many different values of  $b$  within this range, and the desired  $b$  is the one for which the residual variance is a minimum.

Convenient bounds on  $b$  do in fact exist since  $b$  is the ratio of a number less than 1 (the proportionality factor) to a number which is greater than 1 (the cost per mile of transporting distilled spirits expressed in terms of cents) and hence lies between 0 and 1. Of course if the variables are measured in different units, the same result can be obtained by adjusting the units of  $B_m(p_m - p_j)/A_{mj}$  so that all such terms are greater than 1, in which case  $b$  must be less than 1 to ensure that the product of  $b$  and any such term is a fraction (equal to  $w_{mj}/v_{mj}$ ). Consequently equation (8) was estimated for different values of  $b$  between 0 and 1 using a finer and finer grid, and the regression with the highest  $R^2$  value was selected.

Since the error term in equation (8) is a complicated function of the two disturbances ( $e$  and  $u$ ), the four parameters, and all the independent variables, the estimates obtained by this method are not the same as those obtained from a maximization of the likelihood function. The latter procedure is very difficult because the distribution of the error term is complicated. The complexity results from the fact that the disturbance contains, in particular, terms involving products of  $e$  and  $u$ , which are themselves normally distributed. For this reason the unweighted sum of squared residuals was minimized, a procedure sometimes referred to as quasi-maximum likelihood.

## II. Results

Equation (8) was estimated with a sample of 42 observations.<sup>6</sup> Missouri, Wyoming, Louisiana, and Alaska were omitted due to the unavailability of price data. Nevada, Florida, and Hawaii were excluded on the grounds that recorded per capita consumption of distilled spirits would be strongly influenced by out-of-state tourist expenditures—a factor which the model does not take into account. Conceivably New York should also have been omitted for this reason, but the fact that its population is so large suggests that the effect of tourist expenditures on per capita consumption is likely to be small. Mississippi was excluded because it does not permit sales of any distilled spirits, while the District of Columbia was excluded because of its size.<sup>7</sup>

<sup>6</sup> The sources and nature of the data used are described in the appendix.

<sup>7</sup> Exclusion of continental states results in a slight specification error in the formulation of consumption patterns in neighboring states. The omission of the District of Columbia probably affects seriously only the consumption specification for Maryland since prices in the other neighboring state, Virginia, are not very different from those in the District. On the other hand, the consumption variable may be slightly misspecified in many of the nearby non-bordering states. This possibility exists because District prices are lower than all others and because a large number of professional people travel to and from the area, thus providing an occasion for transporting liquor. The District was excluded because the estimation procedure requires that the region of price advantage be approximated by a term of the form  $B_{jd}d^*_{jd}$ , which is inappropriate for an area as small as the District. Further, it is not possible to treat the price advantage area as a circle with radius  $d^*_{jd}$  since the area would then involve  $d^{*2}_{jd}$ , and the unknown transportation cost parameter  $g$  would enter in squared form.

The estimated regression equation, in the form of (1) is:

$$(9) \quad c_{jj} = -.4615 + .0004379y_j - .00375p_j \quad R^2 = .714$$

$$(.632) \quad (.000089) \quad (.011)$$

where

$c_{jj}$  = number of cases (12 fifths) of spirits sold in  $j$  to residents of  $j$

$y_j$  = disposable income in dollars, per adult resident of  $j$

$p_j$  = price of distilled spirits in dollars, in  $j$

$R^2$  = the fraction of the variance of  $c_j$  explained by the independent variables appearing in equation (8)

and the values in parentheses are asymptotic standard errors.<sup>8</sup> The estimate of  $b$  is not presented since its magnitude depends on the scaling of the  $B_{mj}(p_m - p_j)/A_m$ , terms as described above, and hence its magnitude is not meaningful. However, the ratio of  $b$  to its standard error is highly significant, being approximately 2.8. It is interesting to compare this equation with the one obtained by assuming no interstate liquor traffic, that is, by regressing observed average consumption on average disposable income and price for each state:

$$(10) \quad c_j = .5084 + .0004079y_j - .1771p_j \quad R^2 = .5312$$

$$(.414) \quad (.000068) \quad (.072)$$

In this case  $b=0$  by assumption and  $w_{jj}/w_j=1$  for all  $j$ .

It is not surprising that the coefficient of  $p_j$  takes on a much larger value in this equation than in (9). It is surprising, however, that the price coefficient becomes negligible and insignificant when interstate effects are included, suggesting that the large and significant price coefficient obtained in the misspecified model is completely spurious. The spuriousness results because observed high per capita consumption values in low-priced states include purchases from other states, and low consumption values in high-priced states reflect the fact that some residents are induced to purchase outside the state. A model which ignores such effects will clearly overestimate the influence of price changes on consumption changes.

On the other hand, there is no reason why the effect of disposable income on the consumption of spirits should depend on interstate liquor traffic, and indeed the estimated coefficients in the two equations are very close, the slight discrepancy probably arising because of the specification error involved in assuming that  $b=0$  in equation (10).<sup>9</sup> Although the parameter

<sup>8</sup> It should be realized that since the disturbances are not normally distributed there is a specification error involved in the asymptotic standard error calculations, which are based on the assumption of maximum likelihood parameter estimates. Letting  $L(v_i)$  be the logarithm of the likelihood function (assuming the disturbances are normally distributed) and  $v_i^*$  the parameters estimated by the iterative procedure outlined above, then the variances of these parameters are the diagonal elements of the matrix  $(-\partial^2 L / \partial v_i^2)^{-1}$  evaluated at  $v_i^*$ , where  $v_i$  are equal to  $a_0, a_1, a_2$ , and  $b$ .

<sup>9</sup> A different question which arises in connection with the income variable concerns the extent to which the quality of liquor depends on income levels. That is, at certain income levels

estimates corresponding to other values of  $b$  are not recorded here, it should be reported that for the set of  $b$  values selected from the feasible range, the  $R^2$  value increased steadily from .53 to .71 and decreased monotonically thereafter.

Although the price elasticities can be readily calculated for each state, the negligible value of the price coefficient (in relation to the variable means) implies that the elasticity of an individual's consumption with respect to price will be approximately zero.<sup>10</sup> Nevertheless it is interesting to separate the elasticity of total state consumption into its several parts. Denoting the elasticity of a variable  $x$  with respect to price by  $E_x$ , then the overall price elasticity of demand for distilled spirits in state  $j$  (that is, minus the percent change in sales in  $j$  divided by the per cent change in price) may be written as:

$$(11) \quad E_{C_j} = E_{C_{jj}}(C_{jj}/C_j) + \sum_m E_{C_{mj}}(C_{mj}/C_j)$$

where the summation is over all neighboring states ( $m$ ) with a higher distilled spirits price.  $C_{mj}$  in turn may be written as  $w_{mj}c_{mj}$  (for  $m=j$  as well as for any neighbor states) from which it follows that:

$$(12) \quad E_{C_j} = (E_{w_{jj}} + E_{c_{jj}})(C_{jj}/C_j) + \sum_m (E_{w_{mj}} + E_{c_{mj}})(C_{mj}/C_j).$$

Consequently an increase in the price of distilled spirits in state  $j$  can be thought of as having a fourfold effect on sales within the state. The average consumption by residents of  $j$  and by residents of  $m$  who buy in  $j$  declines, while the number of residents of  $j$  and the number of residents of other states, who buy in  $j$ , decreases.

As mentioned above, individual price elasticities, represented by  $E_{c_{jj}}$  and  $E_{c_{mj}}$ , are very small due to the negligible price coefficient  $\alpha_2$ . In fact none of the elasticities obtained by setting  $E_{w_{jj}}$  and  $E_{w_{mj}}$  to zero (a situation which might be approximated, for example, if a tax increase in one state were

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additional disposable income may result in the purchase of higher quality spirits, rather than in an increase in the gallonage of spirits of the same quality. A priori one would expect this phenomenon to be more important at high than low income levels. Countering this tendency, however, is the possibility that at high income levels income increases will result in larger additional expenditures on distilled spirits because of the luxury-good nature of the product. The proposition that the coefficient of disposable income ( $\alpha_1$ ) is dependent on income levels may be tested in a number of different ways. The two methods used here were the following. First  $\alpha_1$  was expressed as a linear and then as a quadratic function of income, and second a dummy slope variable for income was introduced for states with incomes lower than the median. The results in no way supported the hypothesis that  $\alpha_1$  is dependent on the level of income (either in a positive or negative fashion) and for this reason the assumption of a constant value for  $\alpha_1$  was retained.

<sup>10</sup> It should be realized that this in no way contradicts the conclusion that interstate price differences are important. That is, it is certainly possible for total consumption of distilled spirits to be insensitive to prices, while the distribution of the total over states depends on individual state prices. This is analogous to the proposition that total savings is independent of the rate of interest but that the distribution of this total among different earning assets depends on the particular rate of return of each.



matched by increases in several neighboring states) exceeds .1, with the average being .027. On the other hand, the total elasticity average is .084, the maximum value is .33 and values exceed .1 in 11 states. This suggests that in general the decrease in a state's liquor sales resulting from a price increase will not be large, and further, that a significant part of the decrease will be attributable to increased out-of-state purchases, and/or decreased purchases by residents of neighboring states.

The elasticities obtained by assuming no interstate liquor traffic ( $b=0$ ) differ drastically from those just cited. In 29 of the 44 states the estimates are greater than unity, with the unweighted average being 1.27. These results clearly demonstrate the danger involved in ignoring interstate effects, an omission which leads to a serious overestimate of the price elasticity of demand.<sup>11</sup>

Values of the income elasticity are not recorded, but it should be reported that the average elasticity derived from the equation which takes interstate traffic into account is 1.69, while the average under the assumption that  $b=0$  is 1.70. As mentioned above there is no good prior reason for expecting these two values to differ except to the extent that the estimated income coefficient in equation (10) is affected by the specification error involved in setting  $b=0$ .

An estimate of the fraction of a state's population which purchases liquor within that state is given by  $w_{jj}/w_j$ , and can be calculated once  $b$  is known.<sup>12</sup> The results (including Florida and Nevada) are summarized in the following table.

TABLE 1—DISTRIBUTION OF STATES BY PER CENT OF POPULATION  
BUYING DISTILLED SPIRITS WITHIN THE STATE

Per Cent of Population Buying Within the State	Number of States
100	9
99 or over	24
98 or over	31
97 or over	32
96 or over	37
90 or over	43
87 or over	44

<sup>11</sup> The empirical literature on price elasticities provides a wide range of values. The main findings of these works have been recently summarized by J. L. Simon [3]. Simon also presents his estimates based on a quasi-experimental approach using states as simple points, and concludes that the price elasticity is substantially below 1. It should be noted that the latter method does not take into account interstate effects and hence the price elasticity estimate will be biased upwards. Finally mention should be made of a recent work by H. S. Houthakker and L. D. Taylor [2]. In a detailed study of consumer demand in the United States these authors find that the relative price of alcoholic beverages enters *positively* in a regression of per capita alcoholic beverage expenditures on total per capita personal consumption expenditure, the relative price of alcoholic beverages, and a World War II dummy variable.

<sup>12</sup> To a first approximation  $w_{jj}$  may be interpreted as the residents of  $j$  who buy spirits within their state; derived by subtracting from the adult population of  $j$  those persons who

In 24 states 99 per cent or more of the population buys within the state and in one state, Massachusetts, the percentage drops below 90. The major reason for the latter is the extremely large price differential which exists between New Hampshire and Massachusetts. The states which fall in the range of 90 per cent or over, but less than 96 per cent, are Kentucky, Maryland, Minnesota, Oklahoma, South Carolina and Tennessee. In nine cases the entire population buys within the state, implying that prices in all neighboring states are higher.

One interesting application of the model involves a determination for each state of the extent to which existing revenues from distilled spirits depend on interstate liquor traffic. Consider first the license states, in which taxes are the source of government revenue. To permit comparability among states the gain or loss in revenue in each state due to interstate traffic is expressed as a percentage of existing revenue. The gain attributable to such traffic for state  $j$  is  $t_j \sum_m C_{mj}$  where the summation is over all neighbor states with a higher distilled spirits price, and as a percentage of the total is  $\sum_m C_{mj} / (C_{jj} + \sum_m C_{mj})$ . This magnitude therefore represents the percentage by which revenue would be reduced in  $j$  if the laws were strictly enforced. On the other hand, the loss for state  $j$  attributable to the existence of interstate purchases equals  $c_{jj} t_j \sum_k w_{jk}$ , that is, it equals the number of out-of-state purchasers multiplied by the tax rate in  $j$  and by the average expenditure of these buyers if forced to buy in  $j$ , where the summation extends over all neighbor states with a lower price. Expressed as a fraction of total revenue in  $j$  this is  $c_{jj} \sum_k w_{jk} / (C_{jj} + \sum_m C_{mj})$  and may be interpreted as the percentage by which revenue in  $j$  would increase if all out-of-state purchases were stopped.

The analysis for the monopoly states is similar. The fact that government income accrues from a markup over delivered price instead of from a state tax does not present a problem as long as it is assumed that the costs of the government operation are spread evenly over all sales. In this case the ratio of gross revenue attributable to out-of-state buyers, to the total, is given as before by  $\sum_m C_{mj} / (C_{jj} + \sum_m C_{mj})$ , with the markup factor cancelling. Similarly the ratio of revenue lost to the total is the same as for the license states.

The net position of state  $j$  may therefore be expressed as  $(\sum_m C_{mj} - c_{jj} \sum_k w_{jk}) / (C_{jj} + \sum_m C_{mj})$  which takes into account the possibility that the state is bordered by both lower and higher priced states. A positive value denotes a net gain and a negative value a net loss due to the existence of interstate traffic. New Hampshire and Vermont appear to be the main beneficiaries of out-of-state purchases, a cessation of which would reduce tax revenue from the sale of distilled spirits by approximately 53 and 26

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buy in other states. However, the model is formulated so as to take into account the possibility of a person buying some liquor in his own state and some in a neighboring state. Therefore strictly speaking  $w_{jj}$  does not represent the total number of persons in  $j$  buying in  $j$ , but equals "the equivalent number of persons in  $j$  buying solely in  $j$ ." For example if all residents of a state always purchase one-half of their liquor within the state, then  $w_{jj}$  will equal one-half of the residents.

per cent respectively in these two states. Over 5 per cent of existing liquor revenues in the states of Wisconsin, West Virginia, Virginia, Iowa, Rhode Island and North Carolina can be attributed to out-of-state purchases, the values being 10.6, 9.2, 8.0, 5.6, 5.6 and 5.0 per cent respectively. Massachusetts, Kentucky, and Maryland are suffering the highest (per cent) losses in tax revenues with values of 14.2, 8.9 and 6.1 per cent. Since neither Massachusetts nor Kentucky permits the importation of spirits for personal use and Maryland permits only one quart, it is conceivable that in these states (and perhaps in others) the revenue increase obtainable from law enforcement would outweigh the cost.

### III. Conclusion

It has been demonstrated that the omission of interstate effects from a simple cross section model depicting the pattern of distilled spirits consumption leads to a serious error in estimation of the price elasticity of demand. Although the existence of large price differentials between states makes the problem of interstate purchases particularly relevant for distilled spirits, clearly the applicability of the model is not restricted to this classification of goods or areas. That is, the technique may be useful in studying neighboring states with different general sales tax rates, or different excise tax rates (such as on cigarettes) for example, and in studying problems involving areally distributed demands not related to state boundaries.

### DATA APPENDIX

Data are for the year 1960.

The  $C_j$  values are apparent consumption, obtained from *The Liquor Handbook* [1, pp. 24, 26]. License state data are based on tax collections while monopoly state data are based on gallonage shipments to wholesalers.

The price index  $p_j$  was calculated as follows. The retail sales prices of leading brands of different types of distilled spirits were weighted by the apparent consumption of each type. The brands and types of spirits are: blended whiskey—Seagrams 7 Crown; straight whiskey—Old Crow; bonded whiskey—Old Forester; scotch whiskey—Haig and Haig 5 Star; Canadian whiskey—Seagrams V.O.; gin—Gordon's; rum—Carioca; brandy—Coronet V.S.Q., vodka—Smirnoff. Prices of the leading brands used in the index calculation are averages of prices prevailing on January 1, 1960 and 1961. The latter were obtained from *The Liquor Handbook* [1, pp. 54 and 62].

The values of  $B_{jk}$  were obtained by direct measurement from a map of the United States. Borders which did not appear as straight lines on the map were either assumed to be linear or were approximated by two or three line segments. The reason for this is that the area of price advantage is given by the rectangle  $B_{jk}d^*_{jk}$ , hence what is desired is generally a linear approximation to a meandering border.

The values of  $A_{jk}$  and  $v_{jk}$ , the area and adult population of selected counties, were calculated as described in the text. The adult population was calculated by multiplying the population in the counties by the ratio of adult to total population in the state.

The values of  $y_i$  are total state disposable income in 1960 divided by the state population over 21 years of age.

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### A Curious Solution to the Problem of Optimal Price Regulation

Setting an optimal price for a decreasing-cost privately owned "public utility" has been a persistent problem in welfare economics. On the one hand, if price is set equal to marginal cost of production, the utility must be subsidized. This subsidy may entail undesired welfare redistribution. On the other hand, the subsidy may be eliminated by setting price equal to average cost, but then necessary conditions for efficiency in the sense of Pareto may not be satisfied.<sup>1</sup>

A curious but rather special solution to this problem was suggested by a recent electric company advertisement. Where the utility had previously claimed that "electricity is penny cheap—costs less than it did thirty years ago," the new campaign offered an explanation; electricity is cheaper today because "larger consumption means larger plants and more efficient production." If consumers take this message literally, they will know that there are economies of scale in electric generation and that an increase in their collective consumption will bring about lower regulated electricity rates.

The advertisement raises two questions: Why would a regulated utility provide its consumers with such information? What are welfare implications of consumers possessing such information? In the process of answering these questions, a third solution to the optimal regulated price problem will appear, a solution in which it is possible for average cost price regulation to be Pareto efficient.

#### I. Why It Pays the Utility to Inform Consumers

For the sake of simplicity, consider an economy which is in a stationary state prior to the new advertising campaign. Periodically, say annually, a public regulator sets a price  $p$  for the utility commodity  $Y$  equal to average cost (including normal profit) at the rate of output observed in the preced-

<sup>1</sup> See [1].

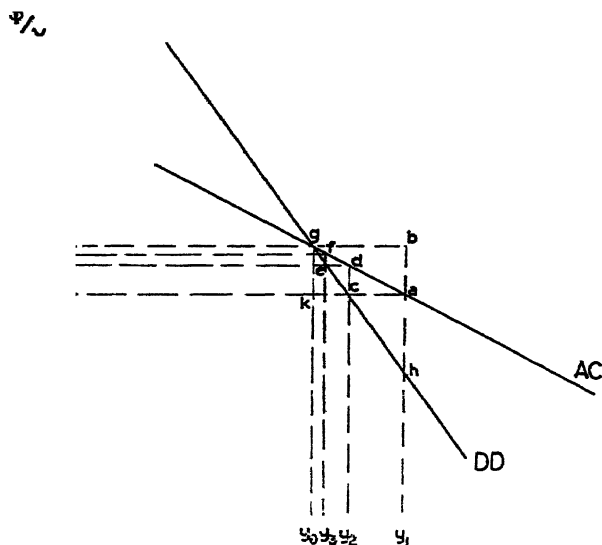


FIGURE 1

ing period. In Figure 1,  $y_0$  was last year's output rate and  $p_1$  is this year's regulated price.

Demand  $DD$  and average cost  $AC$  curves are fixed by the stationarity assumption. Hence the utility cannot expect to earn more than normal profit in this or succeeding years unless it can persuade consumers to behave in a way not indicated by their demand curve.

Suppose the utility can persuade consumers to increase their current purchases to  $y_1$ , say, at the current regulated price  $p_1$ . The regulator will set next year's price  $p_2$  equal to average cost at the output rate  $y_1$  and, since average cost is declining, an abnormal profit represented by the area  $p_1 p_2 ab$  will be generated this year. If consumers continue to purchase as much as  $y_1$  next year and subsequently, the utility will earn at least a normal profit in each future time period so that this year's abnormal profit would be clear again.

If consumers fail to buy as much as  $y_1$  next year, less than normal profit will be earned in that year. Suppose, for instance, that consumer purchases are  $y_2$  at the regulated price  $p_2$ . Then next year's losses will be the area  $p_2 p_3 cd$  and regulated price the following year will be  $p_3$ . If consumers purchase  $y_3$  at the price  $p_3$  in the third year, additional losses represented by  $p_3 p_4 ef$  will be generated. Continuing in this way and assuming that consumers purchase at least the quantity indicated by their demand curve at each year's regulated price, it is clear that cumulative losses after the first year can be at most the area  $p_1 p_2 ag$ ; losses can be as large as this only if each year's purchase is infinitesimally smaller than the previous year's purchase. Subtracting the worst possible loss from this year's gain leaves the area  $gab$ .

Hence the utility can expect to gain a net at least equal to the area  $gab$  if it can persuade consumers to purchase  $y_1$  this year.

If consumers can be persuaded (truthfully) that an increase in current consumption will bring about a lower regulated price next year, they will gain by increasing current purchases by some small amount in order to obtain the benefits of a lower price next year. A consumers' surplus argument will illustrate this. We need only show that there exists some positive  $dy = (y_1 - y_0)$  such that this year's welfare loss (the area  $ghb$ ) is no greater than next year's welfare gain (the area  $p_1 p_2 cg$ ) given the new regulated price  $p_2$ . With  $p = P(y)$  being the equation of the demand curve and using linear approximations for small increments so that  $P(y_1) = P(y_0) + (dP/dy) dy$ , this year's welfare loss is

$$\frac{1}{2}(P(y_0) - P(y_1))dy$$

or, equivalently,

$$(1) \quad -\frac{1}{2} \frac{dP}{dy} (dy)^2.$$

With average cost given by  $A(y)$ , noting that the regulatory mechanism sets  $p_i = A(y_i - 1)$ , and again using linear approximations so that  $A(y_1) = A(y_0) + (dA/dy)dy$ , next year's welfare gain is greater than

$$(A(y_0) - A(y_1))y_0$$

(the triangle  $gkc$  has been neglected). Equivalently, next year's gain is greater than

$$(2) \quad -y_0 \frac{dA}{dy} dy.$$

Combining (1) and (2), consumers' welfare gains are at least as great as their losses as long as

$$0 \leq dy \leq 2y_0 \frac{dA/dy}{dP/dy}.$$

The right-hand side is positive so an increment  $dy$  can always be chosen which will make consumers better off.

Thus, when consumers are informed about the behavior of regulated price, it is in their best interests to increase current consumption and, when current consumption is increased, the utility always gains profits it could not otherwise have earned. If time discounting were introduced, quantitative results would be modified but qualitative conclusions unchanged.

In fact, however, the utility can expect to do better than previous discussion suggests. For, suppose consumers can gain by increasing one year's consumption by some small amount in order to obtain a lower regulated

price in the following year. If the increment in consumption does not exceed that which maximizes their gain, then it will always pay buyers to consume at least as much in the second year as they did in the first. Thus, if this proposition is true, the utility can expect to earn at least a normal profit next year and in succeeding years so that this year's abnormal profit is clear gain; the only way the utility can earn less than normal profit is if successive years' purchases grow smaller.

A proof by contradiction of the needed proposition is possible. Essentially, one can show that, over time, consumers stand to lose all of their second year gains by failing to purchase as much in successive years as in immediately prior years, a loss that can be prevented at smaller welfare cost than the welfare given up in the first year to obtain the second year benefit. Hence, a contradiction arises when the proposition is assumed false.

The above conclusions are true even if each consumer only takes account of the effect of his own rate of consumption on next year's price. If such were the case, it would pay each consumer to make some slight increase in his current demand in the expectation of a resulting slight decline in price. The result would be a larger decline in price since all consumers would have increased current purchases for the same reason. The utility's current period profit could have been larger if each consumer were persuaded that the collective result followed from his individual decision; for then the apparent increment in each consumer's welfare due to an increase in his current consumption would be larger, and this would lead to larger current demands. In this sense, the advertisement which initiated this discussion may be regarded as having both a persuasive and an informative purpose. In view of the negligible effect a single consumer's purchases might be expected to have on price, the persuasive purpose must be regarded as much more important than the informative purpose.

The utility can overstate its case only by persuading consumers that the expected price decline (and resulting welfare gain) is larger than the actually resulting decline (and gain). As long as the utility does not overstate its case in each time period, it will always earn at least a normal profit and may expect to earn more in some periods. Overstating the case could lead to unnecessary losses, however, as consumer expectations are disappointed.

If the case is not overstated, a declining sequence of regulated prices will have been generated by the introduction of consumer information into the otherwise stationary economy. Since this sequence must be bounded, it will converge, presumably to a price consistent with equilibrium in a new stationary state. If the utility's case is neither overstated nor understated, convergence may occur in one period.

## II. *Welfare Implications*

To examine welfare questions, we construct a purely static analogue of the new stationary state. The price  $p$  of the public utility good  $Y$  is now adjusted continuously by the regulator. All other markets are perfect (price equals marginal cost of production) and consumers regard all prices except  $p$  as given. Consumers are aware of the effect their consumption de-

cisions have on the regulated price of  $Y$ . The precise nature of the information and a method of transmitting it will be developed below.

The particular welfare question we want to ask is: Does the new steady state economy satisfy necessary conditions of Paretian efficiency? Under assumptions made, we need only ask whether or not marginal cost to a consumer of his last unit of  $Y$  (the incremental price of  $Y$ ) is equal to the marginal cost of producing  $Y$ .

If  $y_i$  is the amount of  $Y$  consumed by the  $i$ -th consumer, his spending for  $Y$  is simply  $py_i$ , and the incremental price of the last (infinitesimal) unit consumed is

$$(3) \quad \frac{d(py_i)}{dy_i} = p + \frac{dp}{dy_i} y_i.$$

Since the consumer knows that the price of  $Y$  depends on the rate at which  $Y$  is consumed, the second term on the right-hand side will not be zero.

A change in the regulated price due to a change in the  $i$ -th consumer's consumption will induce changes in the consumption of all other consumers, and their changes in consumption will affect price as well. Assuming the  $i$ -th consumer has been correctly informed about price behavior, the derivative  $dp/dy_i$  must be interpreted accordingly. Regarding  $p$  as a function of all consumers' demands for  $Y$ , we have

$$(4) \quad \frac{dp}{dy_i} = \sum_j \frac{\partial p}{\partial y_j} \frac{dy_j}{dy_i}$$

where the summation is over all consumers.

Interpreting this expression, the left-hand side represents the total change in  $p$  induced by a change in  $i$ 's consumption of  $Y$  with all markets except that for  $Y$  fixed. On the right hand side,  $\partial p/\partial y_j$  is the rate at which price changes in response to  $j$ 's change in consumption of  $Y$ , the consumption of all other consumers held fixed. This rate, set by the regulator, is the same for all consumers and is equal to the slope of the average cost curve. If average cost is  $C/y$ , we may rewrite expression (4) as

$$\frac{dp}{dy_i} = \left( \frac{dC}{dy} \frac{1}{y} - \frac{C}{y^2} \right) \sum_j \frac{dy_j}{dy_i}.$$

The remaining terms  $dy_j/dy_i$  represent the rate at which each  $j$ 's consumption of  $Y$  varies with  $i$ 's consumption, all other markets fixed. Since a change in  $i$ 's consumption is known to affect the regulated price and since  $j$ 's consumption will depend on price, these terms will not be zero.

With this interpretation and noting that regulation requires  $p=C/y$ , we are entitled to rewrite the  $i$ -th consumer's incremental price of  $Y$  (equation (3)) as

$$\frac{d(py_i)}{dy_i} = \frac{C}{y} + \left( \frac{dC}{dy} \frac{1}{y} - \frac{C}{y^2} \right) \sum_j \frac{dy_j}{dy_i} y_i.$$



It is apparent that if (and only if)

$$(5) \quad \sum_i \frac{dy_i}{dy_i} y_i = y,$$

where  $y$  is aggregate demand, then the necessary condition

$$\frac{d(py_i)}{dy_i} = \frac{dC}{dy}$$

of Paretian efficiency will be satisfied.

We inquire into conditions under which equality (5) will be satisfied. Aggregate demand  $y$  is simply the sum of all consumers' demands. But each consumer's demand depends (through the effects of changing regulated price) on all other consumers' demands. In particular, all other consumers' demands depend on the  $i$ -th consumer's demand so that, from the standpoint of this consumer, aggregate demand is a function of the  $i$ -th consumer's demand.

Since

$$\frac{dy}{dy_i} = \sum_j \frac{dy_j}{dy_i},$$

equation (5) will be satisfied if (and only if)

$$y = \frac{dy}{dy_i} y_i.$$

Hence, using this result and by Euler's theorem and its partial converse, a necessary and sufficient condition for equality (5) to hold is that aggregate demand for  $Y$  be locally homogeneous of degree one in  $i$ 's demand  $y_i$ .<sup>2</sup> In other words, the necessary conditions of Paretian efficiency are satisfied if and only if aggregate demand for  $Y$  varies in proportion to  $i$ 's demand in a neighborhood of the steady state equilibrium.<sup>3</sup>

Satisfaction of the Paretian condition for all consumers requires that aggregate demand satisfy the homogeneity condition for any single consumer's demand; if any one consumer changes his demand by a given per-

<sup>2</sup> See [2, pp. 378, 380].

<sup>3</sup> More directly, (5) implies (is implied by)

$$\sum_i \frac{dy_i}{y_i} \frac{y_i}{y} = 1$$

which implies (is implied by)

$$\frac{dy}{y} = \sum_i \frac{dy_i}{dy_i} \frac{y_i}{y} \frac{dy_i}{y_i} = \frac{dy_i}{y_i}$$

$$dy = \sum_i \frac{dy_i}{dy_i} dy_i.$$

centage, then the operation of the market for  $Y$  must ensure that all consumers change their demand by the same percentage. The intermediating variable between one consumer's demand and another consumer's demand is, of course, the regulated price  $p$ . Since price is the same for all consumers, it follows that the elasticity of demand for  $Y$  must be the same for all consumers; for if  $y_i$  should increase by  $A$  per cent resulting in a total decrease in  $p$  of  $B$  per cent then  $y_i$  must have increased by  $A$  per cent also; the elasticity coefficient would be  $A/B$ .

Since the elasticity condition is obviously sufficient as well as necessary, we arrive at the following conclusion: The static analogue of the new steady state (with consumer information) satisfies necessary conditions of Paretian efficiency if and only if the elasticity of demand by each consumer for the utility product  $Y$  with respect to its regulated price is the same for all consumers in a neighborhood of the steady state consumption. The information needed by each consumer is the total change in regulated price per change in his own consumption, taking account of induced changes in other consumers' demands.

Note that marginal cost price regulation cannot imply satisfaction of the Paretian conditions when consumers are so informed. With information, consumers react to incremental price and

$$\frac{d(py_i)}{dy_i} \neq p = \frac{dC}{dy}$$

It has been implicitly assumed that information transmission is costless. It turns out, however, that very little information is needed. In the static case, all that is needed is a rate card for each consumer showing a schedule of prices and quantities calculated on the assumption that aggregate demand varies proportionately with individual demand. Since we do not require all individuals to have the same demand (only the same elasticity of demand), it may be necessary to have separate rate cards for each individual (or group of identical individuals) to ensure that all pay the same price at equilibrium. If all consumers have chosen an optimal consumption using such a rate card, if all have the same elasticity of demand, and if the economy is in a steady state, then the necessary conditions of Paretian efficiency will be satisfied.

Although possibly constructed for other purposes, the real world rate cards sometimes used by public utilities may be imperfect counterparts to ideal rate cards. In a similar sense, the advertisement which initiated this discussion may be regarded as an imperfect persuasive counterpart to ideal consumer information.

Finally, in the more realistic case of intermittent regulation and in contrast with the standard public good case, the utility has both powerful means and substantial incentives to acquire and disseminate correct information to consumers.

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\* The author is assistant professor of economics at Stanford University. My colleagues, Ronald McKinnon and Bridger Mitchell, have contributed materially but remaining errors are my own.

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### On the Efficiency of the High School Economics Course

G. L. Bach and Phillip Saunders, writing in this *Review* about two years ago, presented data which showed that high school students who had completed an economics course scored significantly better on the SRA "Test of Economic Understanding" than did students with no economics training. While such a result is perfectly consistent with notions most people hold that students with training tend to score better on tests than students without training, Bach and Saunders cautioned the reader against concluding that the higher scores were necessarily the result of the fact that students in that group had taken a high school economics course while students in the other group had not. Rather, they said, "other variables (for example the possibility that brighter students tend to take separate courses in economics and the fact that economics courses are primarily offered in the 'better' schools) may account for some of the difference [in mean scores]" [1, p. 335].

While Bach and Saunders indicated that they felt the course actually did increase students' ability to answer questions like those on the Test of Economic Understanding, their data did not allow them to make any more positive statements. This paper is an attempt to determine whether the apparent relationship is truly causal or merely an artifact of the data. In the process the study may help resolve the question of whether economists should continue to recommend that high schools encourage college-bound students to take a course in economics.

The data in this paper, taken from a sample of university students and not strictly analogous to those presented by Bach and Saunders, indicate that neither ability, school size (as a proxy for quality), nor any of several other variables is sufficient to account for the advantage high school trained students showed on a test of economic knowledge given just before these students began their college principles course.

On the other hand, the data show that the initial advantage for these trained students was much diminished during the period of a one-semester principles course. The initially untrained students were able to "catch up" during the semester, possibly because students with high school training were not really challenged by the college course.

#### I. Methodology and the Source of Data

The students tested were registered in a one-semester principles course taught by television at the University of Illinois during the spring semester, 1967.<sup>1</sup> Administrative problems prevented choosing these students at ran-

<sup>1</sup> The course at the University of Illinois meets three times each week, with two 50-minute television lectures and one 50-minute discussion session handled by graduate students. Slightly

dom from all students enrolled in the course during the semester, and it is possible that some process of self-selection occurred in registration. It is not evident, however, that such a process did in fact exist, and the authors feel that these students are fairly representative of the large numbers of students who enroll in the course each year.

Each student was given a 50-question initial test of the multiple choice variety used for several years in similar classes, a 60-question final examination containing questions similar (but not identical) to the questions on the initial test, and a questionnaire to ascertain the person's previous training, major field, and other personal and educational characteristics.<sup>2</sup> University of Illinois records were searched, and American College Test (ACT) composite scores were found for as many students as possible. The sample of 281 students described in this paper included only those for whom data on all the variables were available. The remaining 75 students who completed the course had not taken the pretest or did not have an ACT score available for use in the analysis.

The following variables were used in the regression:

$Y_1$  = score on the initial test

$Y_2$  = score on the final test

Continuous regressors

$X_1$  = ACT composite score (an index of ability)

$X_2$  = total semesters of mathematics completed in high school and in college

Dichotomous regressors

$E_1 = 1$  completion of a formal high school course in economics

$E_2 = 1$  completion of a previous college course in economics. For most of these students, this was a beginning course in agricultural economics

$S_1 = 1$  high school size: 500-999 students

$S_2 = 1$  high school size: 1000-1999 students

$S_3 = 1$  high school size: 2000 or more students  
high school size: 0-499 students

( $S_1$ ,  $S_2$  and  $S_3 = 0$ )

$F_1 = 1$  major field: humanities (except social science)

$F_2 = 1$  major field: engineering

less than half of the lectures cover microeconomics; the remainder cover macroeconomics, money and banking, and foreign trade.

The 24 television lectures are taped and, with a study guide which students must buy, are in use in four other institutions. The lectures and the study guide have been in almost constant revision during the last ten years.

During the semester covered by this study students were also required to buy a copy of Samuelson (sixth edition). An assignment sheet showing topics covered and chapters assigned is available from the authors.

<sup>2</sup> The mean score on the 50-question initial test was 26.06 with a standard error of .308. The range of scores was from 13 to 38 correct. On the 60-question final examination the mean was 45.16 with a standard error of .368. The range was from 26 to 59 correct. Specific course objectives covered by items in the test may be secured from the authors.

$F_2=1$  major field: mathematics or natural science

$F_4=1$  major field: social science

major field: residuals—agriculture, fine arts, home economics,  
etc. ( $F_1, F_2, F_3$  and  $F_4=0$ )

$C_1=1$  class standing: sophomore

$C_2=1$  class standing: junior

$C_3=1$  class standing: senior

class standing: freshman ( $C_1, C_2$  and  $C_3=0$ )

$M=1$  sex: male

In order to show the stability of the coefficients for the training variables (i.e.,  $E_1$  and  $E_2$ ) and to indicate the relative ability of each of the six groups of independent variables to explain variability in test scores, the intermediate equations in Tables 1 and 2 are presented as well as Equations 8 and 9 containing *all* of the variables.

The variables indicating major fields of study were included because it was felt that this might provide a measure of interest (or lack of interest) in economics or of a kind of ability not captured by the ACT score. The relatively poor showing on the initial test of students without high school economics might have been caused by overrepresentation of students from the residual group (e.g., home economics majors) who avoided economics in high school and who do poorly when required to take it in college.

Sex was included as a variable because the instruction booklet supplied with the SRA "Test of Economic Understanding" suggested that men might have a greater intuitive "feel" for economics than women. Untrained men in their sample scored significantly higher on the test than did untrained women. After training the difference was negligible [3].

The class standing of the students (freshman, sophomore, junior, senior) was included because it was possible for our sample (but not for the Bach-Saunders sample of high school students) that any difference apparently caused by training in economics might be merely a measure of the maturity and college experience of students with previous economics training rather than a measure of the importance of their training. Thus, if college students with high school economics tend to postpone college economics, their superior initial performance might be due to maturity rather than to their high school training.

The number of semesters of mathematics completed represented an attempt to ascertain whether the apparent differences in *ability to understand economics* were merely an artifact for *ability to understand the mathematical logic* upon which much of economics is based.

## II. The Findings

Table 1 shows that students who had completed a course in high school economics knew more about economics than those who had no training. No matter what other variables were included in the regressions, students with high school economics training scored approximately 2.5 points higher on the initial test than students without previous training. It seems clear that

TABLE 1—COEFFICIENTS FOR THE REGRESSIONS OF INITIAL TEST SCORE ON THE VARIABLES

V a r i a t e	$X_0$	$E_1$	$E_2$	$X_1$	$X_2$	$S_1$	$S_2$	$S_3$	$F_1$	$F_2$	$F_3$	$F_4$	$C_1$	$C_2$	$C_3$	$M$	$R^2$
1	25.295	2.514**	1.476														.052**
2	8.595	2.333**	2.488**	.661**													.239**
3	25.540	2.509**	1.421		-.034												.053**
4	25.222	2.504**	1.503			-.165	.651	-.211									.056**
5	24.022	2.612**	1.905						1.991	1.711*	1.228	1.642					.072**
6	25.078	2.593*	1.461										.300	-.177	.880		.056**
7	24.101	2.514**	.993													1.677*	.072**
8	5.248	2.696**	2.180*	.746**	-.186	-.261	.796	-.517	.998	.195	.176	.571	1.434*	1.385	3.478**	1.126	.299**

\* Significant at the .05 level (two-tailed test).

\*\* Significant at the .01 level (two-tailed test).

TABLE 2—COEFFICIENTS FOR THE REGRESSIONS OF FINAL TEST SCORE ON THE VARIABLES

V a r i a b l e	$X_0$	$E_1$	$E_2$	$X_1$	$X_2$	$S_1$	$S_2$	$S_3$	$F_1$	$F_2$	$F_3$	$F_4$	$C_1$	$C_2$	$C_3$	$M_1$	$Y_1$	$R^2$
1	45.072	.171	.465															.007
2	27.031	.024	1.558	.714**														.153**
3	44.364	.188	.624		.098													.009
4	45.542	.232	.184			-.258	-.191	.031										.017
5	42.430	.238	1.640						1.029	4.667**	4.630**	2.501*						.080**
6	44.655	.102	.402										.715	1.18	-1.279			.0141
7	43.084	.172	-.339													2.791**		.038**
8	32.616	-1.607	-.262														.492**	.204**
9	25.056	.281	1.604	.693**	-.119	-.536	-1.841*	-.179	.200	2.374*	3.384**	1.315	2.050*	2.754*	1.416	.865		.234**

\* Significant at the .05 level (two-tailed test).

\*\* Significant at the .01 level (two-tailed test).

high schools can and do teach economics to students they send to the University of Illinois and undoubtedly to noncollege-bound students as well.

On the other hand, students who had a *college* course in economics before enrolling in the principles course did not appear to have scored significantly better than those without training (i.e., the coefficient is not significant).<sup>3</sup> The regression analysis reveals, however, that their failure to score well was caused by their relatively low mean ability level. When the effects of differing ability were removed (Table 1, Equations 2 and 8) their mean score was significantly higher than the mean score of students without previous training and even slightly higher than that of students who completed a high school economics course.

Table 2 indicates that by the time the students in the sample completed the college principles course, students without previous training had "caught up" to those with a high school or a previous college course. This result is not unique to the sample chosen for this study. George Dawson and Irving Bernstein, in their study of the effectiveness of high school and college economics courses, also found that the advantage enjoyed by students who had completed a high school economics course had vanished by the end of a one-semester college principles course [2, p. 6]. Since the Dawson-Bernstein report indicated nothing about the relative abilities of students in their sample, however, it was possible that this "catching up" might have been due to the superior ability of those without prior training.

Of the variables used in the regression analysis, *ability* (as measured by ACT scores) is the most important in explaining the variation in test scores. As is ordinarily true in studies like this one, only the initial test score approaches the power of an ability index to explain scores on the final examination. It seems clear that one variable, an index of ability, needs to be included in any study of the factors important to success in economics courses. At the same time, the significant coefficients in Table 2 for major field may indicate that the majors in engineering and mathematics and the natural sciences possess some kind of advantage over students in the residual category and that ACT does not capture this difference. Possibly the difference is due to motivation or study habits rather than ability.

The coefficients of the other variables included in the regressions are interesting, but not especially revealing. School size at best is probably not a good index of school quality. The coefficients for sex do not behave the way the SRA sample would lead us to expect, even though sex when included in regressions with previous training alone, is significant (Tables 1 and 2, Equation 7) both on the initial and final tests. When other variables are included (Equation 8 in Table 1 and Equation 9 in Table 2), the significance of sex "disappears" both on the initial test and the final test. This may be the result of multicollinearity between sex and major (engineering, especially), but an alternative and possibly more plausible explanation is that the men in the sample had higher ability than the women.

The three (out of four) negative coefficients for number of semesters of

<sup>3</sup> Most of the students with college economics had taken a beginning course in agricultural economics.



mathematics (suggesting that the more mathematics a student has the less well he does in economics) are somewhat difficult to understand. Possibly students continuing with mathematics use their time studying other courses and "coast" on economics. Alternatively, it may be that many of the students who are *required* to take additional semesters of mathematics are in fact poorer students than those whose mathematics training stopped at the high school level. On the other hand, it may simply be that economics, like politics in the famous phrase of Mr. Einstein, is more difficult than mathematics and the natural sciences and that people accustomed to the precise relationships of mathematics are confused by the lack of precision in economics.

The coefficients for class (freshman, sophomore, junior, senior) are probably the most interesting of the "peripheral" variables. Equation 6 (Tables 1 and 2) indicates that the class variables are not significant when considered alone. When ability and the other variables are included, however, the coefficients become significant. The data indicate that freshmen do less well in economics than upperclassmen. This is true both on the initial and final test (Tables 1 and 2, Equations 8 and 9, respectively). The coefficient for seniors although fairly large is not significant—possibly indicating that seniors try less hard than sophomores and juniors.

The above findings should be regarded as somewhat tentative because  $R^2$ , the proportion of variation in test scores explained by the variables used, is relatively low even for cross-section data. As suggested above, this may simply reflect the imperfections of ACT scores as an index of ability, school size as an index of school quality or, possibly the absence of a direct measure of student motivation. The low  $R^2$ , however, may also be taken as an indication that a more elaborate model is needed for explaining variations in student learning of economics. Following this lead the authors are presently working on a model incorporating a number of additional variables such as attitudes toward the principles course, attitudes toward economics in general and various environmental factors related to the social and economic characteristics of the students' families.

### III. Summary

The significant differences in scores between groups of students with previous training and students without previous training is rather clearly neither an artifact of the variables suggested by Bach and Saunders nor of the additional variables chosen for use in this study. Students who have had a course in economics before beginning their college principles course are more knowledgeable about economics than their fellows.

By the time students have completed the course in principles of economics, however, they have lost their initial advantage. The reason for this is not clear from the evidence presented in this paper. The results, however, suggest that trained students may be "marking time" in the principles course. If this is true, colleges and universities might experiment with a separate principles course for students who have completed a high school

course in economics or possibly allow students who pass a proficiency examination to begin their college economics training with advanced courses.

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### Macroeconomics of Unbalanced Growth: Comment

In a recent article in this Review [1], W. J. Baumol describes two sectors in the economy: one "technologically progressive" and the other registering only "sporadic increases in productivity." The latter includes services rendered in municipal government, education, the performing arts, restaurants, and leisure time activities, as well as certain types of labor-intensive goods like the "fine pottery and glassware produced by the careful labor of skilled craftsmen" or "large and stately homes" [1, p. 41]. Baumol finds that innovation, capital accumulation, and economies of large scale are lacking in these activities, and that in this sector of slow growth "for all practical purposes the labor is itself the end product" [1, p. 416]. He also states that the actual growth of productivity in a given activity "is a manifestation of the activity's technological structure, which determines quite definitely whether the productivity of its labor inputs will grow slowly or rapidly" [1, p. 416]. I suggest that the slow-growth activities with which Baumol is concerned reflect not the technological structure of their own production but the current technology of consumption as well, and that the latter has been strikingly neglected in measuring output. Consequently, the input-output ratio used to measure productivity in goods industries is frequently inapplicable to the service industries.

#### I

By their very nature, services entail little or no lapse of time between their production and consumption; goods, by contrast, are typically produced at one point in time while distribution, purchase, and consumption in the sense of use occur later. Baumol's category of technologically unprogressive activity where "the labor is an end in itself" is also one where producer and consumer normally have immediate, if not face-to-face, contact and where output com-

monly does not exist at all until it is at once produced and consumed. Even for the products of skilled craftsmen, whose wares presumably endure for some time, consumption in the sense of effective demand frequently precedes production: cabinet-makers, tailors, and other artists typically work to order rather than to stock. To define the "technological structure" of any such activity requires, therefore, analysing consumption as well as production.

A homely example may clarify this approach. Presumably barbershops fall into Baumol's category of technologically unprogressive industries; certainly the barber's labor is, for all practical purposes, the end product of the barber's shop. Census figures show that the number of barbershops has declined less than employment: in 1933, some 117,832 establishments with 128,709 active proprietors reported 71,347 employees; in 1963, 105,516 barbershops had 110,645 active proprietors and 73,503 employees [6, p. 1; 6, pp. 1-7]. Sales per worker amounted to \$1,022 in 1933 and \$4,923 in 1963; this threefold increase should of course be deflated for any meaningful measure of growth.<sup>1</sup> It is about as difficult to increase productivity (decrease labor input per unit of output) as in Baumol's example of a half-hour horn quintet; any attempt to do so is likely to be viewed not only with concern but with some horror by the prospective customer. But is it correct to say that the inherent technological structure of this industry is such that innovation, capital accumulation, and the economies of large scale are lacking?

To answer the question requires considering the technology of consumption: since the barber's services cannot be stored by either producer or consumer, the customer uses up output while it is being produced. Most operations require a one-to-one ratio, but other production functions are rare. And if one views what is consumed in barbershops then innovation, capital accumulation, and the economies of large scale have had enormous impact over the past half-century. I refer, of course, to the invention and development of the safety razor.

Many elementary textbooks cite the razor-blade industry to illustrate scale economies; it has certainly also harbored capital accumulation and innovation. But these occurred within the household as well, as the barber's former customers became innovators mastering a new production function. Razors, which were formerly capital equipment to the barbershop industry, have become consumer goods. A major shift of function from barbers to manufacturers and consumers has occurred, and in the process the output of industry has radically changed. And clearly substantial economic growth has taken place in the activity known as shaving, if not in the activity defined as barbershops. For consumers to acquire the desired state of clean-shavenness requires less labor today than 60 years ago and probably represents a higher level of quality in terms of cleanliness and safety. This suggests that productivity has increased, but does not credit any single "technologically progressive" sector with the increase.

It is the current state of technology in both manufacturing and consump-

<sup>1</sup> Jean A. Wilburn [2] dealing with barbershops and their productivity, provides much more detail, while differing sharply from the argument here.

tion that dictates what services are still performed by barbers. Barbershops today chiefly supply haircuts, with styling (including tinting, waving, and designing and fitting hairpieces) a recently introduced innovation which may or may not become generally accepted. These services cannot be transferred to manufacturers and consumers until technology develops a satisfactory substitute for the barber's skills, not merely his tools of clippers and scissors. But no *a priori* reason exists to suppose that the process of hair grooming must remain stagnant and impervious to technology; in the parallel field of women's hairdressing, home permanents developed an effective substitute for much of the skilled services supplied by beauty operators. And if consumers' tastes are allowed the same role as productive technology (for they stand in the same relation to any given demand function as does technology to any given supply function), long hair may prove to be the decisive breakthrough for the "unprogressive" sector of hair cutting.

This short exercise leads, of course, to the more significant field of marketing, particularly retailing. Baumol refers to "evidence that an ever increasing portion of the nation's labor force has been going into retailing and that a rising portion of the cost of commodities is accounted for by outlays on marketing . . . Ultimately, the activity involved is in the nature of a service and it does not allow for constant and cumulative increases in productivity through capital accumulation, innovation, or economies of large-scale operation" [1, p. 420]. Again, one must examine the technologies of manufacturing and consumption to determine the exact nature of the output of retailers, and how far they lag in productivity gains.

Given a model economy consisting of households and firms, with economic activity divided into production and consumption, most analysts call retail stores firms and what goes on there, production. These decisions reflect the economist's preoccupation with production rather than consumption, and his view of marketing as the service of getting goods from producers to consumers. As in Baumol's description, marketing and retailing are seen as something added to commodities, services which can be evaluated independently of the goods involved. But actual cost estimates and the conclusions about productivity that follow measure the output of marketing as the volume of goods to which these services are applied. Economists and marketing experts use the word "channels" to describe distribution: the capacity of the system, like that of any channel, is stated in terms of the volume handled. In this view, both retailer and consumer are passive, submissive to the manufacturer of commodities, whose output of merchandise provides the measure of retailers' performance and of consumers' purchases. This emphasis on the volume of goods obscures the very great changes in technology that have occurred and leads to faulty conclusions about relative economic growth.

Baumol's mention of self-service, the supermarket, and prewrapping as having "increased the productivity per man hour of the retailing personnel" [1, p. 420] does not adequately recognize the significance of these and other innovations. Substantial changes in the technology of factories and households have, in fact, radically altered the entire nature of retailing. Like barbers, re-

tailers today perform those services which have not yet been shifted to factory or home. It is inaccurate, therefore, to equate distribution with the wholesale and retail industries, or to measure their productivity only in terms of the merchandise handled there.

Packaging is a case in point. The terminology of past generations explained that the distribution system provided time and place utility, as form utility was brought about by production. Wholesalers and retailers furnished storage, over time and in place; they provided the functions of sorting or "breaking bulk" and of physically transporting and transferring commodities from maker or grower to ultimate user. Each of these functions existed in the economic activity of the general storekeeper, circa 1900. He purchased barrels of flour and cornmeal, sides of bacon, bolts of fabric, and cases of lye, literally providing "stores" of goods to the consumers who made frequent purchases of small quantities. The retail clerk dipped into barrels of grain or sugar, poured out the syrup or kerosene, cut off the bacon or broadcloth to break up, for the consumer, the bulk purchase of the store. The clerk measured, divided up, filled a container or wrapped with paper and string, and transferred the commodity to its purchaser. The storekeeper and consumer were in personal contact, face-to-face if not hand-to-hand, over each item. These physical activities have become obsolete with the packaging revolution of the mid-twentieth century, and the conventional measure of productivity finds the retailer handling a larger quantity of goods. But he, independently, does not provide time and place utility more efficiently than before. Instead, technological change at the producing and consuming levels has reshaped the manner in which these functions of providing storage, assortment, breaking bulk, and physical transfer are performed.

Both manufacturers and consumers now provide a considerable amount of storage, through time and in place. Household equipment (refrigerators, freezers or freezer compartments, cupboard and closet space) embodies, of course, both capital accumulation and innovation on the part of consumers. So does the larger fraction of (larger) incomes and wealth represented by consumer inventories, which obviate the need for frequent shopping. Innovation and capital investment have also occurred among those firms which have their own warehousing networks taking over the wholesaler's storage function. (Presumably this change also reflects some scale economies.) The retailer's duties of measuring, dividing, and packaging have been almost completely shifted to manufacturers, but only where consumers have acquiesced or participate willingly in the new technology. (For example, prepackaging of meats and produce has not yet become as common as for dry groceries, stockings, and razor blades where manufacturers have successfully standardized their output. The freshness and quality of meats and produce vary markedly among individual items, and consumers are less willing to substitute transparent wrappings for the service of having these foods displayed for inspection and wrapped at point of sale.) The personal contact between storekeeper and consumer has diminished markedly with self-selection and the checkout counter. The retailer's former selling functions (suggestion, advice, persuasion) now occur in the

manufacturer's advertising, packaging and display and the consumer's receptivity to all this. The physical transfer of what is bought must still occur, but it is frequently separated from the rest of the transaction. (Although the automobile salesman may hand over the keys to a car, other consumer durables require installation after delivery, while the customer picks up soft goods directly from shelves or at a wrapping desk, and takes delivery of goods in a supermarket parking lot after paying for the purchase.) Here, too, capital accumulation (the manufacturer's packaging machinery and the consumer's car) and technological change (everything from plastic materials to electric can openers) epitomize today's means of moving goods from producer to consumer.

Manufacturers, retailers, and consumers all share in the distribution process and the functions that result in time and place utility. Hence it is misleading to measure the output of distribution and retailing as the quantity of goods moved from producers to consumers. The definition errs by implying that distribution consists of a one-way movement from manufacturer or grower to consumer, and that it deals only with goods. In fact distribution involves information and finance as well as goods, and a flow from consumer to producer as well as the reverse. Retailing performs important economic functions even when no goods at all are transferred. A more accurate picture of the output of retailing emerges from a look at what consumers buy. To say that 65 per cent of personal consumption expenditures was spent in retail stores omits a large part of what consumers do in retail stores.

Retailers participate in consumer decisions as well as in their purchases. No one decides to buy a 1965 Ford, and then that bundle of services—installment credit, used-car warranty, reputation for service and integrity, convenience of location—he wishes to add to his Ford. Nor does any housewife decide to buy a pound of butter, and then accompany it with the service of her choice—a speedy supermarket checkout, credit and delivery from a carriage trade grocer, late hours from a Ma and Pa operation.<sup>2</sup> Instead, the consumer's decision of what to buy is inextricably bound up with this decision of where to buy: the housewife has a favorite supermarket and the car buyer selects his vehicle after he has selected his dealer. For consumers, retailers exist as important spheres of economic activity quite apart from any specific item of merchandise they carry.

The retailer operates as a display and information center. While manufacturers' advertising and consumers' word-of-mouth evaluation may provide "pre-sold customers" to many stores, retailers nevertheless allow the potential buyer to preview a product. The shopper can look at the item, react and ask questions about it, visualize it as part of his personal consumption pattern, compare it with substitutes or alternatives, and then make his decision. Note

<sup>2</sup> A study conducted in Cleveland in 1964-65 [4] suggests that the typical family makes three-quarters of its weekly food expenditures during one trip to a supermarket; the average supermarket transaction includes twelve items. Most consumers choose a particular supermarket for its cleanliness, the extent of variety, and the quality of its meats and produce—all "services" which do not enter retail sales figures.

that the retailer's information may be crucial to the consumer whether or not any purchase ensues. This activity cannot enter conventional figures for productivity based on the volume of merchandise sold. Surely a selection from the thousands available in a department store or supermarket is more productive of consumer satisfaction than the same item purchased from a thinly stocked inventory offering little or no choice.

The retailer assists the producer in like fashion. Conventional economic analysis, stressing the power of the market, implicitly assumes a feedback of information from the short-run supply-demand equilibrium to both suppliers and demanders, bringing about the adjustments to a longer-run equilibrium. But there is little or no explanation of how, exactly, this feedback works. In fact, it is a major responsibility of the distribution system. Consumers shopping in stores learn immediately about existing supplies and shape their demands accordingly. The stores' day-to-day operations enable producers to learn about existing demands and to increase, cut back, modify or reprice their supplies. Retailers can supply information without any sales transactions taking place—indeed, presumably one of the most vital pieces of information to a supplier is that sales are *not* taking place, or that sales volume lags behind expectations. And these activities, or the efficiency with which they are carried out, cannot, obviously, be estimated from conventional measures based on the volume of merchandise sold.

Aside from providing information, retailing and marketing encompass much activity that is not adequately represented by and indeed may not enter at all the figures for physical volume of goods handled or for dollar sales. This measure of output and productivity exists partly because of our current ways of doing business. Imagine a change in the system. Suppose that every retail store charged admission to its premises. Suppose that inside, near every merchandise display, there were a coin-operated tape recorder to give a prospective buyer detailed information about the articles on display. Suppose that consumers subscribed to the advertising now published by manufacturers and retailers. Envision push buttons for orders and conveyor belts for assembling merchandise (already envisaged as the next technological breakthrough in retailing) with this operation also carrying a price tag. In such a system, the costs of distribution, of "getting the goods from producer to consumer," would surely be very close to present figures for transportation. The output of retail stores would be revealed as the services—to consumers—of providing display and information, taking and filling orders, and so on. Efficiency could be measured accordingly, and the total number of stores, their accessibility, the assortment of inventory and information they carried, would be important criteria for distribution between producers and consumers.<sup>3</sup>

<sup>3</sup> Between 1948 and 1963 sales per employee in supermarkets increased from \$33.2 thousand to \$50.3 thousand [6, p. 1] [7, pp. 2-6, 2-7]. These figures in no way reflect changes over the same period in service to consumers. The population per supermarket dropped from 76.3 thousand to 12.9 thousand while the average number of items stocked grew from 3,750 (1950) to 6,800, the median hours of operation rose from 65 (1953) to 72, and the percentage of stores open on Sunday went from 16 to 39 [5, pp. 17 and 275, quoting *Progressive Grocer*].

## II

Technological change affecting the nature of output has always posed problems to the conventional definition of productivity in terms of the ratio of labor input to output. How much more productive is today's skilled worker in the appliance industry now that radios are transistorized, washing machines are automatic, televisions are colored, and refrigerators include freezer compartments? Since "consumption is the sole end and purpose of all production" [3, p. 625], the only proper way to evaluate any industry is to set up an input-output ratio consisting of labor and consumption utility. The productivity of all labor inputs—those embodied in goods as well as services, in "technologically progressive" as well as backward industries—should be measured by changes in this ratio, whether less labor is required to evoke a given level of satisfaction or the same labor produces more consumer satisfaction.

While the obstacles to actual calculation of such measures are familiar and insuperable, their implications for the problem at hand are perhaps not quite so familiar. Nobody attempts to measure the productivity of the home appliance industry with a ratio of labor inputs to consumer satisfaction because the first term can be quantified and the second cannot, or at least not in comparable fashion. But refrigerators can be counted and their cubic capacity measured, their temperature levels and power consumption can be calculated, and these various numerical quantities lead statisticians to report the output of an industry in terms of physical production and to use these data for input-output ratios. And this "production" is taken to exist independently of consumption. Indeed the end result of consumer satisfaction is rarely considered. As Baumol points out in a footnote, we may have been deluding ourselves about the automobile industry by measuring its growth in such quantitative terms. Such numerical data do not exist, however, for the output of service industries where "the labor itself is the end product." All we can do is to count the number of appliance repairmen, noting that their services are required far less frequently for today's refrigerators.

As we have seen in two activities—barbershops and retailing—the nature of service output has altered quite as dramatically as in any goods-producing industry. Others fit this judgment—what is the correct definition of "output" for measuring the productivity of appliance repairmen, or hospitals, or government at any level? They all perform "services" that did not exist a generation ago, and that exist today because the technologies of using goods, as well as manufacturing them, have changed.

The essential characteristic of services is not that their technology is backward but that there is an intimate relation between their production and consumption. Where this intimacy exists, little or no distinction can be drawn between labor input and output and, more importantly, little or no separation exists between output and consumption. Consequently, if productivity is measured along conventional lines using a ratio of labor input to output while output is defined in terms of labor, any growth in productivity is impossible, since the input/output ratio so calculated is inescapably 1 or very close to it. It is not, as Baumol claims, the "technological structure" of the activity that



determines its relative productivity, but rather the unit of measure that has been chosen. If it were possible to quantify consumer satisfaction, the output of both goods and services could be measured in comparable terms and then productivity, defined as a ratio of labor input to utility, could be compared among industries or sectors of the economy. The absence of such data, however, indicates that great caution must be exercised in describing the relative growth of goods-producing industries and the service sector.

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#### Macroeconomics of Unbalanced Growth: Comment

W. J. Baumol, in a very interesting paper published in the June 1967 issue of this *Review*, sought to examine the consequences of what he called a powerful economic force operating in our economy: that in certain important service activities—municipal government, education, the arts, restaurants—the impossibility of significant technological improvement tends to increase their costs without limit.

A two-sector model was developed, in which the labor force was held constant, and productivity increased at a continuously compounded rate in one (the "progressive") sector and remained constant in the other (the "nonprogressive") sector. Under the assumptions that costs other than labor are zero, and that money wages in the nonprogressive sector rise with money wages in the progressive sector, the model was used to demonstrate first that costs in the nonprogressive sector rise without limit, and second that an attempt to maintain balanced growth would lead to a transfer of resources from the

progressive to the nonprogressive sector, and a declining rate of economic growth. Two conclusions were drawn from the first result which do not necessarily follow.

Assuming that price equals cost, Baumol concluded first that rising costs create a tendency for the outputs of the nonprogressive sectors whose demands are not highly inelastic to vanish. But Baumol overlooked the fact that *real income*, as well as the prices of nonprogressive goods, is rising and therefore that price elasticity is not a sufficient condition for the demands for certain nonprogressive goods to vanish. Only those nonprogressive goods for which the absolute value of the elasticity of demand with respect to price is less than the absolute value of income elasticity, or those for which the income effect is negative, will tend to vanish.

The particular nonprogressive sectors which Baumol asserts are threatened with extinction because of rising costs (the performing arts, handcrafted goods, gourmet restaurants, and stately homes) would appear to be sectors for which income elasticity of demand is high—luxuries for which the market consists chiefly of the wealthy. If the outputs of these sectors have declined, absolutely or relative to population, it may be the result of a change in the relative *distribution* of income—proportionately fewer of the extremely wealthy who can afford luxury items—and/or it may be the result of a shift in demand, brought about by our changing value system with its emphasis on mass culture and conformity. In any case, the decline cannot be attributed to relative price changes without presenting supporting empirical evidence.

### *The Urban Crisis*

Municipal services fall in the “nonprogressive” category, and therefore their costs tend to rise without limit. Baumol’s second conclusion was that this tendency, intensified by externalities—tax base erosion and increasing per capita demands for municipal services as a city’s population increases—is responsible for urban financial problems.

Here again though, Baumol overlooked the effects of real income increases. We contend that externalities are the basic force creating urban financial problems and that technological inertia in municipal services simply magnifies them. In fact, if we assume no externalities, no productivity changes in municipal services, and positive productivity changes in some other industries, then sufficient revenues to pay for the increasing costs of municipal services could easily be generated out of rising real income with no increase in urban tax rates.

This would be possible because as cities grew, the real per capita outputs of municipal services, measured in terms of levels of protection, would not have to rise. The per capita outputs of the progressive industries would increase because productivity is increasing. Thus in real terms, the ratio of municipal services output to total output would decline. In monetary terms, if Baumol’s wage equality assumption holds, the ratio would remain constant. Given that output equals income, both real and money incomes would rise, and the percentage of total money income allocated to municipal services would remain

constant. To the extent that municipal services are financed by income taxes (such as city payroll taxes) revenues would rise in proportion to income without rate changes. Where property is the major tax base, its value would rise (generating additional revenue) to the extent that property as a factor of production shared in the increasing money income. Sales tax revenues would also increase without rate changes. Thus, with no externalities, additional revenues to partially offset the increasing costs of urban services would be generated under present urban tax structures, and the remainder could be obtained through changes in the tax *structure* without alteration of tax *rates*.

This argument does not eliminate the political aspect of the problem discussed by Baumol. The costs per unit of urban services will, no doubt, continue to rise without any explanation apparent to the layman, whether or not externalities are present. Thus, the unprogressive technological nature of urban services is sufficient to cause embarrassment to urban politicians who have promised to reduce budgets. But without externalities, an urban fiscal arrangement dependent entirely upon a proportional income tax would automatically provide sufficient incremental revenues to maintain the quantity and quality of urban services.

In summary, we have argued that Baumol failed to consider increases in real income in his analysis of the rising relative costs in the service or nonprogressive industries and consequently may have been misled in concluding that declines in the outputs of certain nonprogressive sectors are due to relative price changes; and in attributing the major financial problems of cities to factors inherent in the technological structures of the municipal services industries.

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### Macroeconomics of Unbalanced Growth: Comment

W. J. Baumol's recent article [1] on unbalanced growth is an interesting analysis of the problems of the modern city but its formal analysis does not necessarily point in the direction indicated by its author. Furthermore, the implications strongly implied by Baumol's analysis are as likely to compound the cities' problems as to ameliorate them.

#### I. Baumol's Formal Analysis

For purposes of analysis, Baumol divides the modern economy into two sectors, a progressive sector where technological progress continually increases output per man, and an unprogressive sector where an unavoidable personal element makes it technically impossible to expand output per man indefinitely. Labor, assumed for convenience to be the sole input, is mobile and capable in

both sectors so wages tend strongly to equality. It follows that the relative labor cost per unit of output will rise in the unprogressive sector, with the result that the effective demand for its products will decline unless the relevant income elasticities are large and the price elasticities low. Any effort to hold or increase the share of labor in the unprogressive sector will reduce the growth rate. Thus both the natural thrust of technological development and the policy emphasis on growth work against demand for productive services in the unprogressive sector.

Baumol's purpose is to "offer guidance to policy that eludes micro models." A significant part of his paper is, therefore, found in applications that are said to follow for the modern economy, specifically that: many quality things of life are threatened with virtual extinction (stately homes, hand-made fine pottery, glass and woodworking, *haute cuisine*, fine theater); most of the services provided by municipal governments (education, hospitals, police protection) will rise progressively and *cumulatively* in cost because they fall in the unprogressive group and because externalities tend to make costs of soot fall, traffic and presumably other aspects of urban living rise by approximately the square of the population per "city"; and finally, the cost burden to be borne by the cities is aggravated by the tendency of the more law-abiding and affluent to move to the suburbs which, together with the use of the automobile, results in the underuse of public transportation facilities thus raising their costs, while reducing the city's tax base. After this analysis, it is a little surprising that his recommendations are limited to a rather off-hand endorsement of the Heller-Pechman proposal for the use of federal financial resources to assist the cities.

## II. Analysis of the Formal Model

I have no quarrel with the simplifying assumptions nor with the logical steps. A conviction that Baumol overstates the limitations on the growth of productivity in the unprogressive sectors named is passed over in order to concentrate attention on the strongest hinge of his argument. For his analysis suggests the less likely of at least two logical conclusions, namely that the production in the less progressive sector will tend to diminish.<sup>1</sup> This may reflect Baumol's concentration on the price and income elasticities of goods in the unprogressive sector and to his failure to introduce a specific community indifference curve. The latter seems to rest on an underlying belief that such a

<sup>1</sup> This statement may be stronger than Baumol's intention. But it is suggested by such statements as the following: "*Proposition 2*: In the model of unbalanced productivity there is a tendency for the outputs of the 'nonprogressive' sector whose demands are not highly inelastic to decline and perhaps, ultimately, to vanish" [1, p. 418]. The model is applied to various cases in the following pages. Retailing and education are found to have strong survival value, others less, and on balance it is easy to conclude that the nonprogressive sector taken as a whole will tend to decline relatively, perhaps absolutely, as some sectors become attenuated and others run into progressively more forbidding financial problems. Thus in the section entitled "*8. Conclusion—The Financial Problems of the Large City*," he concludes in part, "These phenomena imply that the activities of the municipality will have to be expanded if standards of city life are to be maintained . . . . It suggests that self-help offers no way out to the cities" [1, p. 426].



tually requires an expansion of the labor force in the unprogressive sector. The southwest quadrant of Figure 1 gives every division of the labor force between the two sectors. The quantity of labor is held constant throughout the analysis. The southeast quadrant delineates the relationship between input and output in the unprogressive sector. For convenience we assume diminishing returns and a zero increase of productivity from time period to time period. Both of these favor Baumol's conclusion that the output of this sector will not increase as technological progress proceeds. The northwest quadrant shows the relationship between labor input and output in the progressive sector in three successive time periods. The rate of progress as shown is constant, for output per unit of input doubles from one time period to the next. In each period constant returns are hypothesized. The latter is also especially favorable to Baumol's conclusion. The northeast quadrant depicts the three production-possibility curves that summarize the two production functions for each year on the simplifying assumption that the latter curves are not affected by the actual output mix of the preceding period. Ultimately, growth of this type will produce a production-possibility curve that is virtually vertical for a considerable distance above point  $x_1$  on the horizontal axis although, of course, it eventually meets the vertical axis.

The thrust of Baumol's analysis clearly follows if the community indifference curves are linear of degree one and intersect the vertical axis as is illustrated by  $I_1$ ,  $I_2$ , and  $I_3$ . The resulting expansion path  $B_0B_1$  shows the effect of "unbalanced growth" if the community indifference curves are of this type.

At the other extreme of linear, degree-one community indifference functions are those which display satiation at some level. One such is illustrated by  $I_4$ . Line  $OS$  can be viewed as the locus of satiation points for  $y$  at various levels of  $x$ . It is evident that the equilibrium mix between  $x$  and  $y$  must lie to the right of  $OS$ , so it follows that constantly increasing productivity in the  $y$  sector eventually requires the shift of virtually the whole labor force to the unprogressive sector if the community preference function is of this type. An extrapolation of  $OS$  reveals, in the present instance, that the quantity of  $x$  must exceed  $\bar{x}$  (with an attendant flow of labor to  $x$  from  $y$ ) before the end of the fourth time interval. Many linear and nonlinear community indifference patterns are easily conceivable, and no particular a priori reallocation of resources is inevitable.<sup>3</sup>

\* These conclusions are not altered in any significant way if we relax the condition that the labor force be held constant, or if a stock of capital is introduced and permitted to grow. Suppose the labor supply were to grow. Then successive labor allocation lines (in the southwest quadrant of Figure 1) would lie parallel to the one shown but farther from the origin. The limits of production of both  $x$  and  $y$  are then progressively extended. The shapes of the corresponding production possibility curves are somewhat altered, being generally somewhat steeper (since the possible extension of production is greater for  $y$ ). If the greater labor force is a consequence of a larger population, the community indifference function is also altered, for example, making  $OS$  lie somewhat closer to the axis (on the assumption that satiation is more properly related to per capita consumption than to aggregate consumption). On the other hand, the growth in the relative abundance of  $y$  as compared to  $x$  is accelerated.

Much the same can be said for the introduction of capital. If capital is equally productive

Baumol's implied choice among the possible social preference functions may strike the reader as far more reasonable than the other theoretical alternatives. We argue below that the implications that Baumol draws are in error quite without regard to this matter. Nevertheless, it should be noted that his implied choice of social preference function is more plausible than persuasive. Consider the move from  $B_0$  to  $A_1$  in Figure 1. Baumol assumes that prices in the progressive sector will be constant so that money wages must rise and, with them, the prices in the unprogressive sector. Thus he seemingly discovers a need for an extraordinary combination of high income and low price elasticities for the products of the unprogressive sector if they are to continue to sell even a constant,  $\bar{x}$ , quantity, and therefore to hold a constant share of the labor force. Yet when one places the shoe on the other foot, the demand for  $y$  is made to seem precarious. Thus, let money wages remain constant. The price of  $x$  then remains constant so long as  $\bar{x}$  of  $x$  is sold. But as the capacity to produce  $y$  doubles with each succeeding time period, the cost (and therefore the price) of  $y$  is halved again and again. Anxious eyes now scan the horizons for adequate markets for the flood of  $y$  that rises progressively and cumulatively.

The latter is the more traditional and natural view since the expanding sector is the one that is more obviously thrust into unknown markets. Yet the latter statement is equivalent to the former (except for the balance of payments with a fixed price for gold), and one approach does not tell more about the probable course of events than does the other.

Better guideposts are probably to be found by examining the demand for the luxuries of bygone days to see if they become inferior (or less superior) goods when their output rose, and by scrutiny of the expenditure patterns of the first, second, and third generation rich to see if, as their affluence grew and became habitual, they turned less to the purchase or endowment of the output of the unprogressive sector.

### III. *Analysis of the Implications*

A number of problems are raised by the implications of the foregoing analysis as viewed by Baumol. One is an extraordinarily pessimistic estimate of the financial capabilities of local and regional governments relative to their bur-

in both sectors, labor productivity rises in both. This leads to the same result as does an increase in the supply of labor except, perhaps, for an altered community preference function appropriate to an altered distribution of income. But one would suppose from Baumol's treatment that capital is more effective in the progressive sector. Assuming that to be the case, it would be like an increase in the supply of labor to the progressive sector unmatched by any such increase in the supply to the unprogressive sector. The increase is, of course, in addition to the gain due to technological progress. This result is shown in Figure 1 by the dashed line in the southwest quadrant and the extension of  $y$ 's production function for the second time period. It will be noted that the production-possibility curve drawn for the third period is attained in the second period. Since the labor force (and presumably the population) is held constant, the community indifference function is not much altered (save by a redistribution of income). Thus the relative abundance of  $y$  grows more rapidly, putting more urgent pressure on the allocation of labor from  $x$  to  $y$ , or the reverse, as dictated by the community preference function.

geoning needs. But if these needs are in consonance with the wishes of the community special problems of finance beyond those always associated with the financing of desired public goods should be encountered only if public goods are a rising proportion of total consumption, or if the institutional problems of financing them become more difficult. No doubt more public goods will be desired, but this does not guarantee an increase of their proportion to national consumption. The flight to the suburbs may worsen the problem of finance but not if the local tax boundaries are made suitable to the situation. The boundary problem is discussed further in connection with the Heller-Pechman proposals.

A second problem is a dilemma which Baumol finds between "rapid growth," which is said to require the shift of additional inputs to the progressive sector, and desirable output which involves the expansion of the unprogressive sector. But what economist calculates growth in physical terms without regard to the preferences of the community? Growth is not furthered by producing, say, ten more of  $y$  at a cost of one less of  $x$  when community preferences favor the one  $x$ . One may argue that the social welfare function and the community preference function are quite different things, and this distinction may be part of Baumol's externalities argument which is the subject of the next few paragraphs—but not his argument on quality.

Finally, and most important, Baumol cites the well-known "externalities" that have become problems of urban life (crowding, air pollution, preferences for the private automobile to rapid transit, and suburbanization) and concludes that his analysis offers theoretical support for the Heller-Pechman proposals to use federal finance to expand the indicated urban services. These proposals certainly have their attractions from the standpoint of fiscal policy but they also involve incompletely resolved problems of resource allocation to public goods.

There is a tendency to assume that public goods are always subject to technological economies because in either case the marginal cost appropriate to optimal rationing is less than long-run marginal cost of the service. Applied to a public good, such as clean air or the use of streets, marginal cost pricing may mean zero pricing. But if free pricing encourages a distribution of population that greatly increases the costs of public goods, and perhaps private goods as well, technological diseconomies are inherent in any expansion caused by the low price. In that case, the subsidy necessary to permit free pricing should be borne in such a way as to discourage such a distribution of population. If it is not so borne, the subsidy to the public good may contribute to the worsening of the quality of life that Baumol, as much as anyone, wishes to prevent.

The Heller-Pechman proposals would use the national taxing power to finance "solutions" to urban problems such as those listed above. They would, therefore, amount to a subsidy to the residents of each community because the taxes paid to the federal government would not be related in a substantial way to the costs that individuals cause by polluting the air, failing to use public transportation, fleeing to the suburbs, etc. Thus, even with the costs



covered by taxes the marginal cost of alternatives to the city-dweller are only imperceptibly affected and the external effects are treated as if external economies of production were always present when in fact diseconomies must often exist. Welfare economics prescribes the imposition of a tax or the charging of a rent in such a way as to prevent wasteful over-expansion of private goods production in such cases. It is not self-evident that this is the wrong prescription for public goods subject to technological diseconomies.

Baumol's analysis of air pollution and traffic problems which finds costs rising by the square of the population density strongly suggests technological diseconomies. If so, what purpose is served by subsidized rapid transit? It is bound to increase the population density near its terminals. It is often instituted as a device to preserve the "central city," the greatest concentration of all. Dispersion of population and enterprises into numerous smaller centers is more in keeping with reduction of the costs of crowding and is increasingly practical with electrical power, high-grade communication, truck transport, and highly educated married women in the labor force who prefer to work close to their homes and the children's schools. It is true that tax values in the central city areas may fall along with property values there, and will rise elsewhere. Aggregate land values and tax collections in the region may fall. But why should highly concentrated urban areas be maintained by subsidy after developments in power, transportation, communication, and the emancipation of the housewife have made another urban pattern more economical?

A more nearly correct application of the externality argument would be to find a way to charge to users the full cost of the urban services, including rents. If traffic jams are more costly to society than to the individuals, some device to raise the cost to the individuals and reduce the number going to the central city is indicated. Limiting parking downtown by police power has been suggested. If some device like this is instituted, and mass transportation still cannot find a remunerative rate structure, a shift away from concentrated central areas is all the more clearly indicated.

The worldwide urban problem may be aggravated by externalities not discussed by Baumol. For example, the cost of children to the individual family has been drastically reduced in most nations by desirable humanitarian policies based on the notion that children should not be penalized because parents cannot or will not limit their families to the size for which they can care. The effect of such policies is the subsidization of children, i.e., treating the production of children as if increasing returns were involved which merit a subsidy if the optimal population size is to be reached. Yet the burden of recent argument is that external diseconomies rather than economies are involved.

In addition, I believe that some of the crowding and attendant urban diseconomies may be due to the greater profusion in the cities than elsewhere of subsidized good quality education, medical services, social services of all types, and especially social welfare services, such as employment agencies, aid to dependent children, unemployment compensation and general assistance. The reader should understand that I favor most if not all of these services. Moreover, some of them may not only partake of the characteristics of public goods but may be produced subject to increasing returns so that it is more

economical to supply them in concentrated central city locations. Nevertheless, if high population density is subject to substantial externalities the social cost of which rises at a cumulatively increasing rate, as Baumol persuasively argues, decentralization and suburbanization might reduce the diseconomies of high population density by more than the cost in lost economies.

In short, Baumol's article can be interpreted (although Baumol might not do so himself) as a rationale for the use of central government power by such means as the Heller-Pechman proposal to preserve an aristocratic structure of tastes, existing structures of local government, and the concentration of population, the latter two of which are based on an outdated system of transportation and communication. An alternative reading of Baumol's model suggests that aristocratic tastes may be a function of income and not be in need of special aids. The theoretical support given the use of federal finance to overcome the effects of externalities in the cities' problems rests on an implied questionable association of external economies with public goods which does not always, and perhaps only seldom, exist. When public goods are subject to external diseconomies a priori welfare analysis points towards taxes or rents designed to modify the choices of individuals rather than subsidies from a central government financed from general revenues, and it points to the decentralization rather than the centralization of urban complexes.

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### Macroeconomics of Unbalanced Growth: Comment

In a recent article in this *Review* [1], W. J. Baumol presents a model in which unit costs of output in the nonproductive sector tend to rise relative to costs in the productive sector. The critical assumption for Baumol's conclusion is perfect wage diffusion. The purpose of this note is to provide an alternative model showing that unit costs in the nonproductive sector may remain constant or even decline under an assumption of wage diffusion when any reasonable demand constraint is allowed.

#### I. The Labor-Proportion Effect

Assume the following production functions:

$$(1) \quad Y_{1t} = F(L_{1t})$$

$$(2) \quad Y_{2t} = G(L_{2t})$$

where  $Y_{1t}$  and  $Y_{2t}$  are real outputs in the two sectors. It is assumed that sector 2 exhibits greater productivity change through time and that  $L_{1t}$  and  $L_{2t}$  are the labor inputs for the two sectors. The wage rates are supposed as

$$(3) \quad W_{1t} = H(t)$$

$$(4) \quad W_{2t} = I(t)$$

Finally assume that the ratio of total spending in sector one to that in sector two is not only a function of time but also that it is proportional to the ratio of total costs in sector one to total costs in sector two.

$$(5) \quad P_1 Y_1 / P_2 Y_2 = C_1 Y_1 / C_2 Y_2 = J(t)$$

Since there is a single input in each sector, we arrive at

$$(6) \quad W_{1t} = [J(t)][W_{2t}][L_{2t}/L_{1t}],$$

which indicates quite clearly that, whatever the wage rates are, there is a connection between their behavior through time involving the demand ratio, and a labor proportion effect.

Although equation (6) allows for a wage diffusion effect, the strength of that effect has to depend on the relative proportion of labor in the productive sector. In other words, it would be questionable to argue that high productivity sectors because of diffusion dominate wage rates in our society unless high productivity workers make up a significant portion of the labor supply. Wage diffusion will only be effective if enough demonstration of that wage level exists in the labor market. The demonstrative effect is measured in our model by the labor proportion ratio.

It is apparent from equation (6) that certain demand shifts as well as labor supply shifts toward sector one may cause wages in the nonproductive sector not to rise and may even cause these wages to decline. The only circumstance under which the perfect wage diffusion of the Baumol model may occur is if

$$(7) \quad L_{1t} = J(t)L_{2t}.$$

Equation (7) is an unlikely circumstance for any long-run period, because it implies that the behavior of relative outputs in the two sectors must follow a very particular and unusual pattern. This behavior will become clearer with the use of the following explicit model.

Assume:

$$(8) \quad Y_{1t} = aL_{1t}$$

$$(9) \quad Y_{2t} = be^t L_{2t}$$

$$(10) \quad W_{1t} = w_1 e^t [L_{2t}/L_{1t}]$$

$$(11) \quad W_{2t} = w_2 e^{rt}$$

$$(12) \quad P_1 Y_1 / P_2 Y_2 = C_1 Y_1 / C_2 Y_2 = A \text{ (constant)}$$

where the variables are as already defined and the wage rates of the two sectors follow the pattern indicated. Equation (10) is equivalent to equation (6) obtained from the general model, where  $w_1 = A w_2$ .

We can derive a necessary condition for wages to be identical in both sectors through time as

$$(13) \quad L_{1t} = A L_{2t}$$

or

$$(14) \quad Y_{1t} / Y_{2t} = A [a/b e^{rt}]$$

That these provisions are unlikely it is only necessary to observe that  $Y_{1t} / Y_{2t}$  has a tendency to increase as economies develop.<sup>1</sup>

## II. Unit Costs and Unbalanced Growth

A critical point in both Baumol's model and ours concerns the unit costs of output in the two sectors. Unit costs in sector one of our model may be shown as

$$(15) \quad C_1 = W_{1t} L_{1t} / Y_{1t} = A [w_2 / b] [Y_{2t} / Y_{1t}]$$

By a similar process unit cost in sector two becomes

$$(16) \quad C_2 = w_2 / b$$

The ratio of relative unit costs is

$$(17) \quad C_1 / C_2 = A [Y_{2t} / Y_{1t}]$$

Equation (17) combined with equation (14) implies that one condition for perfect wage diffusion, i.e.,  $W_{1t} = W_{2t}$ , is

$$(18) \quad C_1 / C_2 = b e^{rt} / a.$$

If for any reason the relative unit costs do not follow the pattern determined in equation (18), the Baumol result is untenable.

## III. Conclusion

Once a labor proportion effect is introduced into the model, as it should be, Baumol's conclusion concerning a rise in the cost of services is not theoretically supported. Wage diffusion will only be effective if enough demonstration of that wage level exists in the labor market. A strong case can be made for a decline in the unit cost of services under an assumption of a

<sup>1</sup> A comparison of Gross National Product data for the United States for the years 1950 and 1960 shows that the percentage of the total for services, trade, and transport rose from 53.2 per cent to 57.8 per cent. In contrast, the industry and construction sector fell from 39.5 per cent to 38.2 per cent. See Gutmann [2, p. 64]. Also, Simon Kuznets in *Economic Growth and Structure* states, "In many countries the share of manufacturing and construction has become stabilized after a while; but the share of the service industries has continued to rise" [3, p. 95].

decreasing relative output from the productive sector, which empirically has some justification [2] [3]. Perhaps Baumol's pessimistic view about the future of the public sector and the arts is unwarranted.

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#### Macroeconomics of Unbalanced Growth: Comment

These few remarks should not be interpreted as a rejoinder, for a rejoinder is neither intended nor necessary. Rather, I take the opportunity to clear up a few misunderstandings about the nature of my hypothesis, which Alice Vandermeulen has dubbed "Baumol's Disease"—misconceptions which have characterized a number of comments on my paper and for which limitations in my original exposition are surely responsible.

1. The primary objective of my article was to explain the rising costs of a number of outputs of what I call the "nonprogressive industries." In particular, I sought to account for the spectacular rise in the cost of municipal services. The allegation that the quality of some of these services is rising is a moot question although it certainly may not be uniformly false. However, it is beside the point for the issue I was raising. If my analysis offers some ground for believing that the cost of education will continue to rise more rapidly than the general price level for the foreseeable future, it is comforting to believe that this may be accompanied by some improvement in educational standards but that fact, if it is a fact, does not reduce the size of the prospective bill that must be paid if we are to provide some given number of days of schooling per child, a goal the community is not likely to surrender lightly.

2. I certainly agree that it would be folly to rule out categorically the possibility of cost-saving innovation in urban services. Subsequent events have belied spectacularly such prognostications for agriculture and for the operation of the kitchen. Perhaps no technological revolution has increased productivity more spectacularly (in terms of audience size per performer) than have the electronic media in the case of the performing arts. Yet because the quantity of labor is so closely correlated with the quality of the final product in so many of the urban services, we have strong grounds on which to expect that they will characteristically tend to lag behind the remainder of the economy in the productivity benefits which they enjoy as a consequence of innovation.

And, as a result, I persist in the view that the extraordinary rates of cost increase that we observe throughout the nonprogressive sector is a matter of their technology—the special role of the labor input in determining the quality of their end product.

3. Having predicted a cumulative cost rise for the output of the “nonprogressive sector” of the economy I did not intend to go further and attempt a generalized forecast of the activities that compose it. I meant to suggest a variety of possibilities: that some, like the construction of stately homes, would tend to disappear; that others, such as very fine restaurants, would be reduced to a small number catering almost exclusively to the very affluent; that some, like handmade furniture and pottery, would fall into the hands of amateur craftsmen; and that some, such as education (at least up to this point) would continue to be demanded but would, as a consequence, eat up an ever-growing portion of G.N.P. I do *not* believe that any one type of time path will characterize the behavior of every output of the nonprogressive sector in the future any more than it has until now. But each of the possibilities involves some consequences which some of us may consider unpalatable and which, at the very least, merit explicit consideration by the policy maker.

4. Of course the Heller-Pechman plan is not the appropriate means for dealing with those who impose external costs upon society, nor has anyone claimed that it is. Clearly, those whose activities produce these costs should, where possible, be made to pay for them. That is still generally the best way to deal with the matter. Nor did I intend by my reference to the Heller-Pechman plan to prejudice whether the community will indeed choose to preserve our cities, at least in the form in which we now find them. I meant only to indicate that *if* society makes such a decision it must recognize that cumulatively rising costs may well force some such financing measure upon it. I may add, incidentally, that since smaller geographic entities must also supply services that are, typically, produced in the nonprogressive sector, decentralization may constitute no cure for Baumol’s Disease. I think symptoms of this are already accumulating.

5. A final word on Professor Bell’s lovely example on our response to the rising costs of barber services: the growth of self-service in the process of shaving. Surely this is a beautiful illustration of one of the consequences I have drawn from my model, the growing inducement for amateur activity. We see it all about us: in cuisine, in dramatic presentations, in orchestral performance, in the making of pottery and furniture—and in beard removal!

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### Foreign Assistance and Economic Development: Comment

The importance of foreign aid and its relationship to economic development will not be denied by either theoretician or practitioner. Nevertheless, the treatment in the literature on this subject has been far from satisfactory to date. In recent years, however, the work of Chenery and his associates

[1, 2, 3, 4], culminating in the recent article by Chenery and Strout in this *Review* [5], has promised to deliver "a theoretical framework designed to analyze the process of development with external assistance in quantitative terms" [5, p. 680]. It is the purpose of this paper to examine rigorously this framework, and to evaluate its validity and operational usefulness.

The essence of the Chenery-Strout (C-S) paper is a proposed method for the estimation of the foreign aid "needed" by a typical less developed society in the course of growth. The two main building blocks of their theory are, first, the recognition that foreign aid can be used to fill either a saving gap or a foreign exchange gap; and second, the proposition that the typical less developed country (LDC) must move through three distinct consecutive stages of growth characterized by a difference in the gap-filling function of aid, i.e., a skill-limited phase, a saving-limited phase, and a trade-limited phase.<sup>1</sup> Furthermore, C-S claim, on the basis of data from 50 countries, that this three-stage thesis of growth is supported by the inductive evidence available.

In order to be in a position to evaluate carefully the merits of the C-S proposition which has become very popular in one form or another in recent years we found it necessary to try to distinguish between two basic elements which are somewhat intermingled in the C-S presentation: the first is their formal model structure; the second is their attempt to justify that structure with the help of more informal extra-model considerations. In Section I we shall try to present a precise and straightforward statement of the formal model structure in such a way as to bring out the full logical implication of that structure. We are then ready, in Section II, to evaluate the C-S ideas of the "typical" life cycle of growth. Finally, in Section III, their attempt to provide an empirical test of the model is scrutinized.

### I. Model Structure

The C-S model structure consists of the differentiation among different growth regimes, the linking of these regimes in a stages theory of growth, and of the different adjustment mechanisms within each regime.

*Growth Regimes.* The C-S model is based on the postulation of an aggregate national income accounting system formed of eight planning variables, i.e.,  $V$ (GNP),  $I$ (Investment),  $C$ (Consumption),  $S$ (Saving),  $K$ (Capital Stock),  $M$ (Imports),  $E$ (Exports), and  $F$ (Foreign Aid)—bounded by any three of the following four independent static accounting equations (1 *abcd*)<sup>2</sup> and one dynamic accounting equation (1e).

$$(1a) \quad M + V = I + E + C \quad (\text{equality of supply and demand for total resources})$$

<sup>1</sup> The *skill limited* phase represents a more recent addition to the Chenery School "two-gap approach."

<sup>2</sup> The fourth can be deduced from the other three. Thus in (1), four independent accounting equations are postulated for the eight planning variables. The reader may be reminded of the fact that four additional behavioristic assumptions must be postulated to have a completely determined model.

- (1b)  $V = C + S$  (disposition of income between consumption and saving)
- (1c)  $M = E + F$  (sources of import financing)
- (1d)  $I = S + F$  (sources of investment financing)
- (1e)  $dK/dt = I$  (investment as the increment of the capital stock).

The behavioristic equations employed by C-S are selected from the following set: (using notation  $\eta x = (dx/dt)/x$  to denote the rate of growth of  $x$ ):

- (2a)  $\eta_I = B$  exogenously postulated constant growth rate of investment (absorptive capacity)
- (2b)  $\eta_V = r$  exogenously postulated constant growth rate of *GNP* (target rate of growth)
- (2c)  $\eta_E = \epsilon$  exogenously postulated constant growth rate of exports (export growth rate)
- (2d)  $\frac{dS}{dt} = \frac{dV}{dt} \alpha'$  implying  $S = (\alpha_0 - \alpha')V_0 + \alpha'V$  where  $\alpha_0 = S_0/V_0$  (marginal saving function)<sup>2</sup>
- (2e)  $\frac{dM}{dt} = \frac{dV}{dt} u'$  implying  $M = (u_0 - u')V_0 + u'V$  where  $u_0 = M_0/V_0$  (marginal import function)<sup>2</sup>
- (2f)  $K = Vk$  (production function based on constancy of capital-output ratio  $k$ ).

Thus there are three exogenously postulated growth rates ( $B, r, \epsilon$ ), two marginal propensities (to import  $u'$  and to save  $\alpha'$ ) and a capital-output ratio ( $k$ ). These six parameters appearing in the behavioristic equations in (2) may be summarized as: ( $B, r, \epsilon, \alpha', u', k$ ).

A special word of explanation with respect to the meaning of  $B$  (in 2a), the only somewhat unconventional parameter in this group, may be helpful. In C-S parameter  $B$  reflects a definition of absorptive capacity in terms of "the skill formation required of managers, skilled labor and civil servants in order to increase productive investment" [5, p. 686]. Thus the "skill" in their skill-limited phase refers specifically to the ability to blueprint and carry out investment projects. The postulation of a constant growth rate of investment  $B$  in (2a) must then be based on the view that the ability to

<sup>2</sup> Notice that  $\alpha_0$  is the initial average propensity to save and  $u_0$  is the initial average propensity to import.



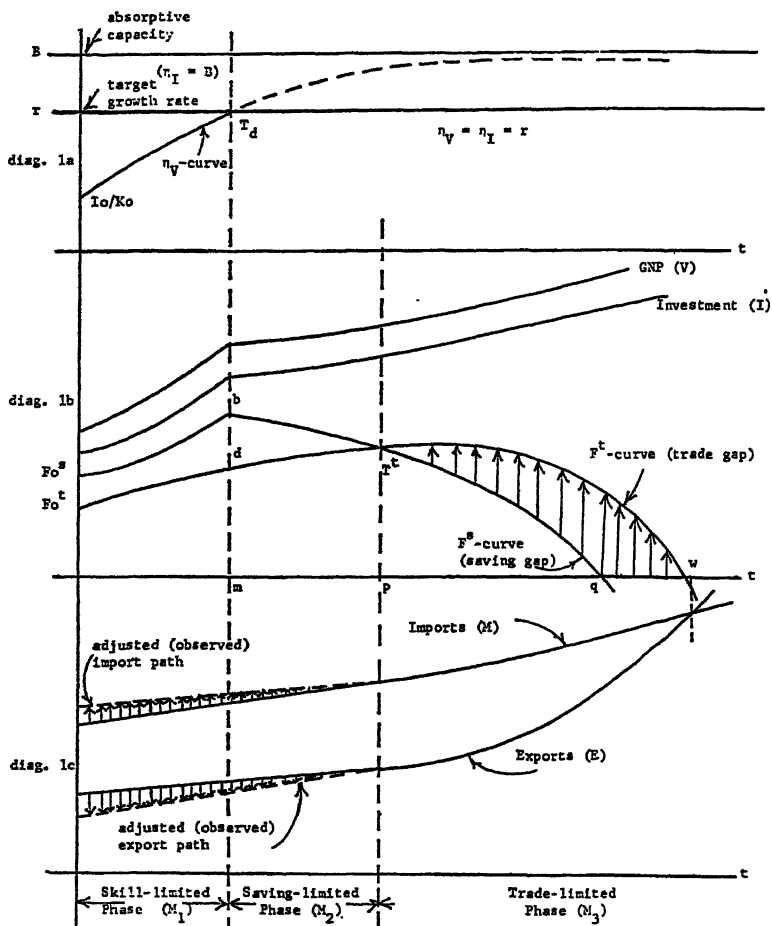


FIGURE 1

invest is augmented through time as the result of a secular learning-by-doing process inherent in the act of investment. In other words, the magnitude of  $B$  describes the rapidity of the learning process.

The behavioristic assumptions in (2) are used by C-S in different combinations to construct three distinct models—to be denoted by  $M_1$ ,  $M_2$ , and  $M_3$  below—as three alternative ways to calculate the needed foreign aid flow through time. The three models are then viewed as three *growth regimes* which appear in some definite sequential order (e.g.,  $M_1$ ,  $M_2$ ,  $M_3$ ) and constitute the three phases of a three-stages growth thesis. This possible sequential ordering of the phases is depicted in Figure 1 in which time is measured on the horizontal axis and the three phases ( $M_1$ ,  $M_2$ ,  $M_3$ ) are marked off by the (dotted) vertical lines as indicated. With the aid of this diagram,

the causal order for the determination of the needed volume of foreign aid in each phase can now be briefly stated.

C-S refer to  $M_1$  as the Skill-Limited Phase, for which assumptions (2a), (2d), and (2f) are selected to close the system. Given the constant absorptive capacity limitation  $B$  of assumption (2a) (horizontal line through point "B" in Fig. 1, diag. 1a) we can determine the time path of investment (Fig. 1, diag. 1b). This gives the time path of the capital stock (by 1e) and hence the time path of capacity GNP (by 2f) (Fig. 1, diag. 1b). With the aid of the saving function of assumptions (2d), we can then determine the needed foreign aid through time (line  $F_o^sb$  in Fig. 1, diag. 1b) as the gap between investment and saving.<sup>4</sup>

Since, in the Skill-Limited Phase ( $M_1$ ), the time path of capacity GNP ( $V$ ) is determined, the growth rate of GNP (i.e.,  $\eta_V$ ) can be easily calculated as (see Appendix):

$$(3a) \quad \eta_V = \frac{I_0}{\theta/sBt + \phi} \text{ where } \theta = K_0 - I_0/B \text{ and } \phi = I_0/B$$

$$(3b) \quad \lim_{t \rightarrow 0} \eta_V = \frac{I_0}{\theta + \phi} = I_0/K_0$$

$$(3c) \quad \lim_{t \rightarrow \infty} \eta_V = \frac{I_0}{\phi} = B$$

Thus the constant growth rate of investment  $B$  leads to the phenomenon of "income acceleration" in Phase I whereby the rate of growth of GNP monotonically increases from its initial value ( $I_0/K_0$ ) to a long-run stationary value equal in magnitude to  $B$ , the measured absorptive capacity. (See the  $\eta_V$  curve in Fig. 1, diag. 1a). It should be noted that this income acceleration phenomenon is not only interesting in its own right<sup>5</sup> but is absolutely essential for the C-S "stages of growth thesis"—as will be demonstrated later. For this reason, we feel that the necessary and sufficient condition for income acceleration in  $M_1$ , i.e.,

$$(4) \quad I_0/K_0 < B$$

might have been explicitly stated by the authors.

Moving on to  $M_2$ , the Saving-Limited Phase, assumptions (2b), (2d), and (2f) are now expected to hold.<sup>6</sup> Given  $r$ , the target growth rate of GNP (assumption 2b), represented by the horizontal line through "r" in Fig. 1, diag. 1a, we can determine the time path of GNP (Fig. 1, diag. 1b) as well as the saving path, with the aid of the saving function (2d). Based on the

<sup>4</sup> The time path of saving is the vertical gap between the investment-curve and the aid-curve over time.

<sup>5</sup> It testifies to the importance of the constant absorptive capacity assumption of C-S since, in the long run, the rate of growth of income ( $\eta_V$ ) and capital ( $\eta_K$ ) are all dominated by, and in fact, equal in magnitude to the absorptive capacity limit ( $\eta_V = B$ ).

<sup>6</sup> In Fig. 1, this model applies to Phase  $M_2$ .

constant capital-output ratio (assumption 2f), we can then determine the needed capital stock and thus the needed investment through time (Fig. 1 diag. 1b). Foreign aid in  $M_2$  is then determined as the gap between needed investment and the available domestic saving depicted by the  $bT^t$  curve (in Fig. 1, diag. 1b).

Finally in  $M_3$ , the Trade-Limited Phase, assumptions (2b), (2c), and (2e) are in effect. Once the time path of GNP is determined, with the help of assumption (2b) i.e., a target growth rate,  $r$ , (as in  $M_2$ ), we can, by using assumption (2e), determine the required volume of imports (solid curve in Fig. 1 diag. 1c). With the time path of exports (solid curve in Fig. 1 diag. 1c) determined by the exogenously postulated growth rate (assumption 2c), the foreign trade gap is determined as the difference between imports and exports. (In Fig. 1 diag. 1c, the trade gap can thus be represented by the vertical distance between the two solid curves.)

Thus, for each of the three phases taken separately, we can easily deduce (see Appendix) the time path of needed foreign aid:

$$(5a) \quad F^s = (F_0 + me^{Bt}) - m \text{ where } m = (\alpha_0 - \alpha')V_0 + \alpha'(K_0 - I_0/B)/k \\ \text{(for } M_1)$$

$$(5b) \quad F^s = (kr - \alpha')V_0 e^{rt} - (\alpha_0 - \alpha')V_0 \text{ (for } M_2)$$

$$(5c) \quad F^t = (u_0 - u')V_0 + u'V_0 e^{rt} - E_0 e^{rt} \text{ (for } M_3)$$

The superscripts in (5) serve to remind us of the fact that while the needed aid is determined in the form of filling a saving-investment gap ( $F^s$ ) in  $M_1$  and  $M_2$ , it is determined as filling a trade-gap ( $F^t$ ) in  $M_3$ .

These equations represent the basic instruments proposed by C-S for the purpose of estimating the needed foreign aid over the entire life cycle of growth. In order to prepare ourselves for an examination of this three-phased thesis, some pertinent technical matters must first be disposed of:

1. For each model, separately presented above, there are *seven* equations<sup>7</sup> postulated for the *eight* variables. Thus each model is only partially determined. Our discussion of the causal order above shows that imports ( $M$ ) and exports ( $E$ ) are undetermined in  $M_1$  and  $M_2$  while saving ( $S$ ), investment ( $I$ ), and consumption ( $C$ ) are undetermined in  $M_3$ .

2. Two additional conditions are used, in each model, to determine the values of the above undetermined variables. For  $M_1$  and  $M_2$  the values of imports ( $M$ ) and exports ( $E$ ) are determined with the aid of the import function (2e) and the export function (2c). For  $M_3$ , the values of  $C$ ,  $S$ , and  $I$  are determined with the aid of the saving function (2d) and the production function (2f). In this way a trade gap  $F^t$ , can be determined for  $M_1$  and  $M_2$  while a saving gap,  $F^s (= I - S)$ , can be determined for  $M_3$ . Thus for each model, *two* gaps  $F^t$  and  $F^s$  can be defined. This is shown in Fig. 1, diag. 1b, in which the  $F^s$ -curve and the  $F^t$ -curve extend through all three phases.

3. There thus exists over-determinacy in C-S in each phase since nine

<sup>7</sup> The seven equations include *four* independent accounting equations from (1) and *three* behavioristic equations from (2).

equations are used to determine a system of eight variables. This is explicitly recognized in [4] and can be seen directly from the fact that, in each phase, the saving gap ( $F^s$ ) is not the same as the trade gap ( $F^t$ )—although they clearly must always coincide *ex post*. In short a gap ( $F^s - F^t \neq 0$ ) between the two gaps exists generally throughout the three phases as seen from the vertical distance between the  $F^s$ -curve and the  $F^t$ -curve in Fig. 1, diag. 1b.

This famous gap between the two gaps of the Chenery School, which can be clearly depicted in this fashion, is crucially involved in two ways. First, it relates directly to the turning points between phases in the three-phased growth thesis. Second, inherent in the notion of overdeterminacy is the notion of disequilibrium analysis according to which the gap ( $F^s - F^t$ ), and thus the overdeterminacy, are eliminated [4]. It is to these two aspects of the C-S paper that we shall now turn.

### *Stages of Growth Thesis*

The above three independent growth regimes represent the building blocks with the aid of which the C-S theory of consecutive stages of growth ( $M_1, M_2, M_3$ ) is to be constructed. It is intuitively obvious that, in any such "stages of growth" thesis, the crucial matters are always the turning points (marking off two consecutive regimes) and the contrasting rules of behavior between any two regimes. The exposition in the C-S paper is unsatisfactory in this area in that these crucial matters are dealt with only informally, leaving the reader to find his way with the help of earlier contributions and somewhat casual empirical observations.

To begin with, C-S assume that the needed foreign aid is at all times determined by the larger of the two gaps, i.e.,

$$(6) \quad F = \text{Max } (F^s, F^t) \text{ for all time.}$$

In diagrammatic terms, the aid needed by a typical aid-receiving country over its life cycle can therefore be depicted by the time path  $F_0^s b T^w$  in Fig. 1, diag. 1b. Together with the equations in (5), a procedure to estimate the aid needed emerges which is based on a stages-of-growth thesis marked off by two turning points. Furthermore, C-S also seem to be willing to make certain judgments as to the general shape of some of these curves thus revealing, somewhat hesitantly, their view on the contrasting behavior of needed aid in each phase.

A typical aid-receiving country, according to C-S, often starts in a skill limited phase ( $M_1$ ) with the income accelerating characteristic defined in (4). The rate of growth of income,  $\eta_r$ , will increase and may therefore after some finite time span exceed the target rate of growth of income stipulated for the saving-limited phase,  $M_2$ .

The existence of such a point of intersection,  $T_d$ , between the  $\eta_r$  curve and the horizontal target growth rate curve in Fig. 1, diag. 1a, in fact marks the demarcation between phases  $M_1$  and  $M_2$  in the C-S three-stages thesis.<sup>8</sup> It

<sup>8</sup> "Phase I ends in year  $m$  when investment reaches a level adequate to sustain the target rate of growth" [5, p. 687].

is easy to see from Fig. 1, diag. 1a that the relevant implicit assumption is:

$$(7) \quad I_0/K_0 < r < B \quad (\text{condition for existence of first turning point}).$$

In other words, the essential qualitative assumption concerning the existence of the first "turning point" is that the target rate of growth of income in  $M_2$  lies between the rate of absorptive capacity ( $B$ ) and the initial growth rate of both capital and income ( $I_0/K_0$ ).

Once in the second phase ( $M_2$ ), this typical country will sooner or later move into the third phase ( $M_3$ ) at a turning point marked off by the point  $T'$  in Fig. 1, diag. 1b. The implication is that at this turning point a saving-gap-dominated phase of growth (i.e.,  $F^s > F^t$ ) gives way to a trade-gap-dominated phase (i.e.,  $F^s < F^t$ ). The implicit assumptions of C-S on which this view of the world is based are as follows:

1. *The saving gap ( $F^s$ ) increases in  $M_1$  and decreases in  $M_2$  and  $M_3$ .*<sup>9</sup> It can be shown (see Appendix) that this is ensured by the following condition which C-S must have implicitly assumed

$$(8) \quad r < \bar{\eta}_K < B \text{ where } \bar{\eta}_K = \alpha'/k \quad (F^s \text{ increases in } M_1 \text{ and decreases in } M_2 \text{ and } M_3).$$

The implicit assumption is that  $\eta_V$  must be less than the absorptive capacity ( $B$ ) for  $F^s$  to increase in  $M_1$  and must be greater than the target growth rate ( $r$ ) for  $F^s$  to decrease in  $M_2$  and  $M_3$ .

2. *The trade gap ( $F^t$ ) lies below the saving gap in  $M_1$  and exceeds the latter sometime thereafter—in fact marking off  $M_2$  from  $M_3$ .*<sup>11</sup>

3. *The trade gap ( $F^t$ ) is increasing in  $M_1$ <sup>12</sup> and decreasing thereafter.*<sup>13</sup> The fact that the  $F^t$  curve is inverse U-shaped is assured by the condition (see Appendix):

$$(9a) \quad r < \epsilon < r(u'/(E_0/V_0)) \quad (F^t \text{ inverse U-shaped})$$

$$(9b) \quad u' > E_0/V_0$$

Thus  $F^t$  is inverse U-shaped when and only when the exogenous export growth rate exceeds the target growth rate but not by too large a margin (9a). A necessary condition for this to occur is that the country has a low initial propensity to export ( $E_0/V_0$ ) and a high marginal propensity to import (9b).<sup>14</sup>

The above, in brief, represents a recapitulation of the logical content of

<sup>9</sup> See reference to "rising capital inflow in Phase I" [5, pp. 689, 690].

<sup>10</sup> "In Phase II, . . . in order for the rate of capital inflow to decline, the marginal saving rate  $\alpha'$  must exceed the investment rate  $k$  required by the growth target" [5, p. 688]. This is a part of the condition stated in (8) in the text.

<sup>11</sup> ". . . the trade limit may replace the saving limit as a determinant of the capital inflow in either Phase I or Phase II . . . it is more likely to be during Phase II" [5, p. 690].

<sup>12</sup> ". . . (In Phase I), the rising capital inflow does not usually require exports to increase as fast as imports" [5, p. 690], resulting in an increasing trade gap.

<sup>13</sup> "Once a target growth in GNP is attained, however, exports must rise more rapidly than imports if aid is to be reduced" [5, p. 690].

<sup>14</sup> If (9b) is not satisfied the trade gap increases monotonically.

the two turning points in the C-S three-phased thesis—as well as an exposition of certain qualitative aspects of the system within each phase. It should be emphasized that while C-S do not claim any logical necessity for a particular sequence to obtain there is a clear presumption that ( $M_1, M_2, M_3$ ) is somehow typical or preponderant. For any other possible sequence (e.g.,  $M_2, M_3, M_1$ ), alternative behavioral assumptions to those cited would have to be introduced to give meaningful economic content to such a sequence and to the turning points between the phases. Moreover, this would mean a change of the structural parameters which is not, in fact, permitted in the C-S model. In evaluating the C-S position, one should therefore be entitled to examine it in terms of what is clearly their stated view of how a “typical” fixed parameter country, e.g., Greece [1] or Israel [2] behaves [see 5, p. 690, fn. 23].

### *Disequilibrium Adjustment Process*

Since we know that the magnitude of the saving gap and of the trade gap must be the same *ex post* (i.e., since, after the fact, foreign aid must be able to plug both gaps simultaneously), the existence of a “gap between the two gaps” implies that some *ex ante* behavioristic assumption is not really effective in each phase.<sup>15</sup> The assumed availability of aid to plug the larger of the two gaps led C-S to assume that in  $M_1$  and  $M_2$  the restrictive nature of one or both of the trade assumptions (2c) and (2e) may be relaxed, while, in  $M_3$ , the saving assumption (2d) may be relaxed.

In  $M_1$  and  $M_2$ , imports may, in fact, be more than what is needed and/or exports may be less than capacity. This *ex post* adjustment possibility can be indicated in Fig. 1 diag. 1c by the dotted curve representing an upward adjustment of the import curve and/or a downward adjustment of the export curve by such amounts that the (increased) *ex post* trade gap at each time will be exactly the same as the saving gap.

Conversely, in Phase III, because foreign aid is assumed to be adequate to plug the (larger) trade gap, the domestic saving capacity will not be fully utilized—i.e., some potential saving will, in fact, not be realized. In Fig. 1, diag. 1b, this is shown by an upward shift of the  $F^s$ -curve until it coincides with the  $F^t$ -curve in  $M_3$ —indicating that a smaller part of investment is financed by domestic saving than what would have been the case had foreign aid been not so liberal.

If the aid giver really is so generous as always to provide the needed aid according to the principle of filling the maximum gap (6), aid recipients will encounter little difficulty in adjusting via the pleasant route of higher imports, lower exports, and lower saving. A situation—which, unfortunately, is more likely to occur in the real world—arises when the aid giver is willing to donate *less* than the maximum gap and hence the aid recipient is forced to make the unpleasant kind of adjustment in the opposite direction. C-S do not deal with this more realistic type of adjustment to disequilibrium. This, we believe, is a basic weakness of their analysis of the “demand” for aid.

<sup>15</sup> See our earlier discussion on overdeterminacy.

## II. *The General C-S Thesis*

What we have presented above is the formal part of the stages-of-growth thesis presented in the C-S paper. Actually, the validity of this thesis is based, not so much on the internal logical structure of the model, as on their intuitive view of the process of development in long-run historical perspective. In order to appreciate the formal portion of their thesis it is essential to share their general vision which is largely extra model in nature.

C-S believe that a typical aid-recipient country initially finds itself limited by its deficiency in the skills required to undertake investment projects—a deficiency which can only be removed by education and a secular learning-by-doing process. The investment skill in this initial phase is the development bottleneck in the sense that the implied demand for funds for investment is small relative to the combination of available domestic saving and projected foreign aid. Moreover, the implied needed amount of imports—in spite of limited export capacity—is even smaller.

Over time, growing skill levels lead to a continuous expansion of the rate of growth of GNP. However, the expansion, if unchecked, would lead to an unreasonably high level of demand for foreign aid. The government then seeks to adopt self-disciplinary measures, symbolized by some given target rate of growth of GNP to curb the rate of expansion of the demand for foreign aid.<sup>16</sup> Simultaneously, domestic austerity measures are adopted to ensure that the demand for foreign aid satisfies the criterion of self-help (i.e.,  $\alpha'/k > r$  in (8)) which implies the downward movement of needed aid towards an ultimate termination date (point  $q$  in Fig. 1, diag. 1b).

In spite of such relative domestic austerity and other self-help efforts, the country is once again faced with a pressing demand for foreign aid from another source, this time the inflexibility in the productive structure, which manifests itself via a country's inability to reduce its import demand through import substitution and/or to expand its exports through export promotion. This nonflexibility between domestic and foreign resources then becomes the effective limiting factor determining the volume of needed foreign aid. The resulting trade gap can be closed in the long run only when the potentiality of export expansion (coupled with import substitution) is larger than the growth target (i.e.,  $\epsilon > r$  in (9a)).<sup>17</sup> Provided this condition

<sup>16</sup> [5, p. 686]. In fact there is an abrupt curbing of the expansion of the economy at the turning point (between  $M_1$  and  $M_2$ ). This can be visualized in Fig. 1, diag. 1a, in at least two ways. First the increasing trend of  $\eta_T$  in  $M_1$  gives way to a constant value of  $\eta_T$  in  $M_2$  or  $M_3$  (i.e., income acceleration phenomenon ceases). Second, the constant rate of investment at the value  $\eta_T = B$  in  $M_1$  is replaced by a lower value  $r$  (i.e.,  $\eta_T = r$ ) in  $M_2$ .

<sup>17</sup> This long-run adjustment to bring about structural flexibility is considered to be a modification of the "short run model" which is the basic model of C-S. C-S acknowledge the possibility of searching out a "more efficient growth path" under the assumption of "coordinated development policies and a planned adjustment of the trade gap and savings gap" [5, p. 697] for the purpose of reducing the projected aid requirement.

We shall limit our discussion to the short-run limited flexibility model of C-S which they used to evaluate current performance as well as to make 5 to 10-year projections. In our view, the art of foreign aid projections is not sufficiently advanced to render anything more than 10-year projections very meaningful.

is satisfied, the country can be said to move through its life cycle to ultimate termination of aid.

Such a consecutive-stages-of-growth thesis ( $M_1$ ,  $M_2$ ,  $M_3$ ) must be judged, first of all, on the basis of the reasonableness of the above theoretical vision. The essential content of any such thesis (with well-defined phases of growth marked off by turning points) must lie in the justification of the inevitability of the transition from one stage to the next, i.e., why do the forces operating in one phase necessarily lead to the dominance of other rules of growth in a later phase? This would be equally true of any other sequences the authors might put forward. In the present C-S three stages thesis ( $M_1$ ,  $M_2$ ,  $M_3$ ), the occurrence of two turning points appears to be attributable to a host of forces—socio-political, technological, and economic—the operation of which conforms to a rather special historical view of growth:

1. The turning point between  $M_1$  and  $M_2$  occurs when, threatened with the unwillingness by foreigners to continue to underwrite a rising growth rate, the government intervenes by the adoption of a reasonable target rate of growth to suppress the uninhibited growth rate propelled by the ever-rising ability to invest. This is, at best, a hybrid turning point thesis. It is composed in part of socio-political arguments of external feasibility with respect to the willingness of foreigners to underwrite the cost of rising growth rates and in part of the feasibility of an internal consensus on the appropriate controlled growth target. It also entails a particular view of technical factors since the abandonment of investment ability as the dominant constraint signifies that the country is sufficiently mature technically to be able to absorb all domestic and foreign saving likely to be made available and channel them into efficient investment outlets.

2. The turning point between  $M_2$  and  $M_3$  occurs when the deficiency in the flexibility of the economy's production structure becomes more of a bottleneck than the deficiency in its saving capacity. In the present paper [5] the C-S view appears to be that, in the course of the maturing process, the country acquires an aptitude for austerity earlier than an aptitude for the exploration of foreign markets.

It is clear that any such three-phased thesis represents a specific view of the metamorphosis of a less developed country, i.e., that it will acquire first an aptitude for organizing and investing, second, for austerity, and finally for achieving technological flexibility, in that order. The authors, it is true, are careful to point out (in a footnote) that the three phases described "can follow each other in any order if we allow the structural parameters to change at random over time. With fixed parameters, the commonest sequence is from Phase I to either Phase II or Phase III" [5, p. 690, fn. 23]. But the particular "normal" metamorphosis presented here is built, as we have shown, on a number of rather arbitrary assumptions which are not deduced from accepted hypotheses in economics or elsewhere. The simple truth is that the theory of economic transition is still in an embryonic stage. It is probably unsafe to describe a particular development sequence based on aptitudinal change as typical for all—or even most—underdeveloped countries. The same difficulty would presumably attend other sequences not dealt with in [5].



The injection of a politically based target growth rate,  $r$ , moreover, raises questions of a different nature as well. It is not clear whether a politically controlled growth target has to be introduced early, or late in the course of the growth process. It is certainly doubtful that such a target will ever be used to suppress investment ability, as C-S seem to be claiming. Finally, even when a target growth rate is announced, there is a basic question as to whether the typical underdeveloped "mixed economy" has the necessary socio-political machinery to implement the planned target effectively.

In short, we find the C-S three-phased growth thesis stimulating and provocative but rather unconvincing on a priori grounds. The question then naturally arises as to whether it can be tested empirically. The C-S paper is certainly impressive in terms of its abundance of statistical data and the impression is strongly conveyed that such a test has, in fact, been performed. Let us now examine the nature of this empirical work.

### III. *Empirical Analysis*

Ideally, inductive evidence can be used to support or refute the central thesis of any legitimately constructed economic model. As far as the three-stages thesis of C-S is concerned, this means that we should be able to verify its validity by looking at the historical experience—as measured, for example, by sufficiently long statistical time series for the variables  $V, I, S, C, M, E, F, K$ —of some underdeveloped country, or countries, which has presumably moved through all three phases of the life cycle. C-S did not attempt such an historical approach and, we believe, for a very good reason, namely, that it cannot be done.

Because of the shortness of the post-World War II foreign aid experience, it is probably true that not very many contemporary underdeveloped countries have, in fact, completed all three stages of the kind of life cycle put forward here. Pakistan, which is treated by C-S as the "model case" throughout their paper, is described as "for the past eight to ten years following the sequence envisioned in our Phase I." [5, p. 691]. No other country is proposed by C-S as a typical country which has gone through all three phases in the past and for which a historical verification of their thesis is attempted. Thus, verification based on the experience of a contemporary underdeveloped country is difficult.

However, we suspect that the three-phases thesis, in its present form, is not amenable to historical verification even, say, 50 years from now when some country surely will have completed the alleged life cycle. This is basically due to the fact that the C-S thesis depicts only a partial picture restricted to the demand for foreign aid. The other half of the picture, i.e., the supply of foreign aid, is completely absent from the framework of the analysis. Historical verification in fact cannot be undertaken at any time for the simple reason that the *ex post* experience of growth is bound to be the product of the interaction of demand and supply conditions.

To illustrate this, we can imagine that in addition to the saving gap curve ( $F^s$ -curve) and the trade gap curve ( $F^t$ -curve) in Fig. 1, diag. 1b there

exists an  $F^a$ -curve which denotes the supply (or the availability) of foreign resources. We can then define an excess of  $F^s$  over  $F^a$  as an inflationary gap—in accordance with Keynesian terminology—and an excess of  $F^a$  over  $F^s$  as a balance-of-payments gap. The actual international transfer mechanism has to involve the simultaneous adjustment of all three curves to eliminate any *ex post* difference among them through changes in the level of employment and the growth rate, the price level, the exchange rate, as well as the supply of foreign aid.

It is evident that unless the demand analysis of C-S has also accurately anticipated supply—which is extremely unlikely except under conditions of an unlimited supply of foreign aid—their framework could not be used to analyze historical experience in foreign assistance.

Thus we see that the “typical” three-phases thesis of C-S cannot be supported by empirical evidence of the “backward looking” or historical variety. The empirical justification which is, in fact, attempted in the paper employs inductive evidence in the relatively more modest task of implementing the C-S model in the econometric sense, i.e., to estimate the major parameters of the model and to make foreign aid projections on the prior assumption that the model is, in fact, descriptive of the real world. In this fashion alternative sets of parameter values are first estimated for some 50 countries [5, Tables A<sub>1</sub>–A<sub>3</sub>]. Presumably, these parameter values can then be substituted in the following “necessary conditions” in order to determine whether the “typical” case (depicted in Fig. 1) will or will not result:

$$(10) \quad I_0/K_0 < r < \alpha'/k \quad B \text{ and } r < \epsilon < r(u'/(E_0/V_0))$$

(by (7), (8) and (9)).

If these conditions are satisfied, foreign aid projections can then be made for the “typical” country with the help of (5) and (6).

As a result of implementing the model in this fashion, C-S claim to have discovered that the “same phenomenon [i.e., the switching from Phase I to II to III] occurs in the projections for the majority of developing countries.” [5, p. 695]. It is only in this sense that they claim the support of inductive evidence for their thesis.

But even with this much more limited statistical implementation effort, there are formidable problems to be overcome since the parameters which must be estimated cannot, in fact, be identified. C-S assume that the time series available for a typical country are generated as a country moves through Phase I (i.e.,  $M_1$ ).<sup>18</sup> It is then obvious that, for  $M_1$ , the export growth rate ( $\epsilon$ ), the initial export ratio  $E_0/V_0$ , and/or the import coefficient ( $u'$ ) cannot really be identified. This is due to the fact that, according to the C-S disequilibrium adjustment thesis, the observable actual imports (represented by the dotted line in Fig. 1, diag. 1c) are greater than the needed

<sup>18</sup> We may add that this is, of course, the only legitimate assumption—otherwise the predictive value of their three-phase-thesis is lost.

imports (represented by the solid line in the same diagram)—and it is the *latter* which is needed for purposes of identification. Similarly it is impossible to estimate the initial export ratio  $E_0/V_0$  and the exogenous growth of exports ( $\epsilon$ ), as actual observable exports may be less than the value of potential exports which is needed for identification.

C-S do not face the identification problem openly but seem to have made some quite arbitrary assumptions in attempting to get around it. Their two main assumptions are relegated to footnote c of Table 4 [5, p. 694]. First, in the disequilibrium adjustment process in Phase I, all adjustments are assumed to be made by imports. Thus the initial export ratio  $E_0/V_0$  and the export growth rate  $\epsilon$  can be identified. Second, for Phase I (i.e., for the period 1956–1962 used for estimation purposes), the saving gap is simply assumed to be equal to the trade gap (i.e.,  $F^s = F^t$ ). (In terms of Fig. 1, diag. 1b, the assumption is that the points  $F'_0$  and  $F''_0$  on the vertical axis coincide.) This enables them to estimate the import coefficient ( $u'$ ).<sup>19</sup> There is no justification whatsoever on theoretical grounds for the year picked to be precisely such a year—and why this should be true for all the countries studied. In other words, for identification purposes, an essential aspect of their very thesis—i.e., the existence of a gap between the two gaps—must be sacrificed!

Thus, while the theoretical part of the C-S thesis is based on somewhat indefinite behavioristic assumptions marginal to the domain of economic theory, the empirical part of the analysis is saddled with an as yet unsolved identification problem. But even if we waive all these problems, the fact that a three-phased phenomenon can be produced in the laboratory of planners does not mean that the three-stages thesis is supported by historical fact. It is, in fact, a nontestable thesis for which no amount of historical evidence can ever tell whether it is right or wrong!

C-S have focussed our attention imaginatively on the nature of various constraints encountered in the drive towards self-sustaining growth. But, the really essential issue of any viable growth promotion policy, it seems to us, is how to facilitate the various learning processes (learning to save, to invest, to export, to engage in efficient import substitution) with the help of foreign aid, rather than how to calculate foreign aid requirements if we know these parameters. In addition to concerning ourselves with the materialistic or resources aspects of development, in other words, we must pay increasing attention to the rules governing changing behavior patterns in the course of economic growth.

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<sup>19</sup> For then *ex ante* equals *ex post* and there is no adjustment problem.

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## APPENDIX

For the first model  $M_1$  (defined by (1) and (2adf) ) of the skill-limited phase, we can determine the time path of capital  $K$ , and hence  $V$ , from the time path of investment, by integration. Formally:

$$(A1a) \quad I = I_0 e^{Bt} \quad \text{by (2a)}$$

$$(A1b) \quad K = \int I dt = \theta + \phi e^{Bt} \quad \text{by (A1a) where } \theta \text{ and } \phi \text{ are defined in (3a) in the text.}$$

$$(A1c) \quad V = K/K = \theta/k + (\phi/k)e^{Bt} \quad \text{by (2f) and (A1b)}$$

The rate of growth of  $V$  (i.e.  $\eta_V$ ) in (3a), is obtained directly from (A1c). By differentiating  $\eta_V$ , we have

$$(A2) \quad d\eta_V/dt > 0 \text{ if, and only if, } \theta > 0 \text{ i.e., } B > I_0/K_0$$

which is the condition of income acceleration of (4) in the text. We can next calculate the time path of savings from (A1c) and (2d) as:

$$(A3) \quad S = (\alpha_0 - \alpha')V_0 + \alpha'(\theta/k + (\phi/k)e^{Bt}) \quad \text{by (A1c) and (2d)}$$

The saving-gap,  $F^s$ , for  $M_1$ , as listed in (5a) in the text, is calculated as:

$$(A4) \quad F^s = I - S \text{ for } I \text{ in (A1a) and } S \text{ in (A3).}$$

To investigate the direction of change of  $F^s$ , we differentiate (5a) in the text to obtain:

$$(A5) \quad dF/dt = (F_0 + m)Be^{Bt} > 0 \text{ if, and only if, } F_0 + m > 0 \text{ or } B > \alpha'/k$$

which is a part of the condition listed in (8) in the text.

For the second model  $M_2$  (defined by (1) and (2bdf)) of the saving-limited phase, we can calculate  $V$ ,  $I$ ,  $S$ , and  $F$ , following the causal order discussion in the text. To summarize, we have:

$$(A6a) \quad V = V_0 e^{kt} \quad \text{by (2b)}$$

$$(A6b) \quad I = dK/dt = d(kV)/dt = kV_0 e^{kt} \quad \text{by (2b), (1e) (2f)}$$

$$(A6c) \quad S = (\alpha_0 - \alpha')V_0 + \alpha'V_0 e^{kt} \quad \text{by (A6a) (2d)}$$

$$(A6d) \quad F^s = I - S \text{ for } I \text{ defined in (A6b) and } S \text{ defined in (A6c).}$$

The last equation (A6d) leads to the saving-gap expression,  $F^s$ , for  $M_2$  listed in (5b) in the text. Differentiating  $F^s$ , we have:

$$(A7) \quad dF^*/dt < 0 \text{ if, and only if, } \alpha'/k > r$$

which is the condition of "self help" (i.e., declining  $F^*$ ) in  $M_2$  as listed in (8) in the text.

Finally for the trade-limited phase  $M_3$  (defined by (1) and (2bce)), the time paths of  $V$ ,  $E$ ,  $M$  and  $F^t$  can be calculated—following their causal order discussion in the text:

$$(A8a) \quad V = V_0 e^{rt} \quad \text{by (2b)}$$

$$(A8b) \quad E = E_0 e^{\epsilon t} \quad \text{by (2c)}$$

$$(A8c) \quad M = (u_0 - u')V_0 + u'(V_0 e^{rt}) \quad \text{by (A8a) and (2e)}$$

$$(A8d) \quad F^t = M - E \text{ for } M \text{ of (A8c) and } E \text{ of (A8b)}$$

The last equation leads to the trade gap expression ( $F^t$ ) of (5c) in the text. To investigate the direction of change of  $F^t$ , we differentiate (5c) to get:

$$(A9a) \quad dF/dt = u'rV_0 e^{rt} - E_0 \epsilon e^{\epsilon t} \quad \text{by (5c)}$$

$$(A9b) \quad \text{For } t = 0, dF/dt = u'rV_0 - E_0 \epsilon > 0 \text{ if and only if } \epsilon < ru'/(E_0/V_0)$$

$$(A9c) \quad \text{For } t = \infty, dF/dt > 0, \text{ if and only if } r < \epsilon$$

The last two conditions ensure that  $F^t$  is inverse U-shaped—as indicated in (9a) in the text.

## Foreign Assistance and Economic Development: Reply

The Fei-Ranis critique raises basic questions as to the "validity and operational usefulness" of the type of planning model we have used to analyze the role of external assistance in economic development. The approach in question has come to be called "two-gap analysis." Although the criticisms of Fei and Ranis provide a valid warning against reading too much significance into the mechanics of any simple aggregate model, most of their comments seem rather peripheral to the main purposes of this type of analysis.

### I. *The Nature of Two-Gap Analysis*

The basic concepts of two-gap analysis derive from the linear programming formulation of optimal resource allocation with multiple constraints varying over time. The main ideas were set out in a paper by Chenery and Bruno [2], which explored the effective limitations to the use of varying amounts of external capital in Israel. This approach assumes either that the limits to growth can be determined in advance (for short-term analysis) or that they can be modified by deliberate policy changes (for long-term planning). The simpler short-run formulations of [1] [13] and our Model 1 assume predetermined maxima for savings and exports and a minimum for imports. These assumptions determine the capital inflow needed to sustain a given level of

output. The results also focus on key aspects of economic policy which affect the dominant constraints on the system at a particular point in time.

Our joint paper proposes a simplified two-gap model to analyze the allocation of limited amounts of external capital among countries and over time. The scarcity of foreign capital must be incorporated into the planning model in some way; we have assumed a limit to the growth rate that donors would be willing to support [5, p. 686]. A "target rate" was chosen to accord with common practice among developing countries as well as for computational convenience. The effects of more general assumptions as to capital rationing—either in terms of costs or of available supplies over time—are explored in linear programming versions of the two-gap model [3] [6] [7], and in our paper by varying the growth targets in each country.

The view of the development process that is common to all two-gap studies is that structural disequilibrium rather than neoclassical equilibrium is characteristic of countries attempting to accelerate growth. The two-gap phenomenon is a manifestation of disequilibrium which results from changing availability of external capital and an inflexible mechanism of adjustment. Our basic hypothesis is that the equilibrating reactions in investment, savings, and trade behavior take place over an appreciable period of time and may deviate in varying degrees from optimal instantaneous adjustments. This assumption is analogous to the lagged adjustment mechanisms that econometricians have used with considerable success to explain investment behavior and other dynamic phenomena.

The main question in using two-gap models for planning or prediction is how much foresight and control to assume on the part of policy makers. Our Model 2—which Fei and Ranis ignore—assumes that any inequality between the *ex ante* trade gap and savings gap will be eliminated over a given period (13 years in our example) by reallocating investment.<sup>1</sup>

A linear programming formulation of this problem is used in [3] and [7] to determine the optimal allocation of investment to trade-improving sectors with alternative assumptions as to external capital supply and absorptive capacity. When we assume perfect foresight as to the future supply of external capital and other limiting factors, the "gap between the gaps" is eliminated in most of the optimal solutions. We maintain, however (p. 682), that imperfect foresight is more characteristic of developing countries and that realistic assumptions for longer-term planning lie somewhere between the extremes of our rigid Model 1 and the optimal adjustments of our Model 2. (We discuss other gap-adjustment possibilities on pp. 700-701.)

The structural relations underlying the two-gap approach can be better explored in disaggregated programming models for individual countries. This has been done most recently by Bruno for Israel [6], Tims for Pakistan [12], and Bergsman and Manne for India [10]. These multisectoral studies give more logic and empirical content to the import, export, and investment constraints than is possible in an aggregate model. The basic concepts of struc-

<sup>1</sup> A more flexible version of this mechanism for gap adjustment is contained in a forthcoming paper by Chenery and Eckstein [8].

tural disequilibrium and the likelihood of a "gap between the gaps" become much clearer in these more detailed studies.

## II. *Phases of Growth*

Our general notion of a "phase of growth" derives from the concept of structural disequilibrium implicit in two-gap models. In the terminology of linear programming, a set of binding constraints is associated with the optimal solution at each point in time (p. 687); each set of constraints may be identified as a phase or "regime."<sup>2</sup>

In the fixed-parameter model that we have used to project the demand for external capital, there are four observed combinations of constraints to which we have given descriptive names (p. 692). In the more complex linear programming versions [3] [7], with their explicit gap-adjustment mechanisms, a larger number of regimes is observed in the optimal solutions, but the principal phases can still be characterized by one or two dominant constraints.

We have suggested the concept of a phase as a planning device rather than as a basis for historical analysis. Not only is it useful in determining aid requirements, but it stresses the differences among the policy mixes that are appropriate when there are different sets of limiting factors.

Although the concept of a phase is central to our analytical scheme, the presumption of a given sequence of phases is not. We were led to speculate about the likelihood of particular sequences from having examined a large number of projections from the model. After the model had been restated in optimizing form, a number of solutions were made to determine the properties of efficient growth sequences [3] [7]. The most general description of efficient growth with external assistance emerging from these experiments consists of two parts: (1) A phase in which growth accelerates as rapidly as the skill constraint or other limit to absorptive capacity permits, with no short-run limits on capital inflows;<sup>3</sup> (2) A series of one or more phases in which the structure of the economy is changed to adjust to the anticipated long-term availability of external capital.

Whenever an economy is able to increase its ability to invest capital productively more rapidly than the increase in supply of domestic and foreign financing, there will be a shift from a phase dominated by the absorptive capacity to one dominated by the supply of foreign capital—the basis for our target rate of growth. This is the only inevitable feature of our suggested optimal growth sequence. Although Fei and Ranis doubt that "such a target will ever be used to suppress investment ability," it is evident that this is precisely what has happened in countries such as India, Pakistan, Turkey, and Brazil, where investment plans have had to be tailored to supplies of domestic and foreign financing rather than to the ability to carry out investment.

<sup>2</sup>The latter term was used in Chenery and MacEwan [3] to avoid the implication of a fixed sequence of phases.

<sup>3</sup>A more realistic formulation of this limit in terms of diminishing returns to additional amounts of investment was used by Chenery and Dorfman [7] with results that are qualitatively similar.

There is nothing logically necessary about the sequence of Phases II and III in our projection model with fixed parameters; they can occur in either order or one may dominate indefinitely.<sup>4</sup> It is not the sequence in which the savings constraint and trade constraint become binding but the fact that there is not an automatic mechanism to equate the two gaps in the short run that lies at the heart of our analysis.

### III. *Empirical Verification*

The value of a model for policy purposes can be judged in two ways: (1) whether it provides new insights into the nature of a given phenomenon, and (2) whether it provides useful quantitative estimates of the relations between policy variables and social objectives. On the first score, the principal merit of the two-gap model is to show that the key elements of aid and development policy vary according to the set of factors limiting growth. The practical value of this conclusion depends on being able to identify the binding constraints.

The problem is typically approached by testing some of the indirect consequences of the key hypotheses.<sup>5</sup> We have applied a number of such tests in the more complete version of our paper [4] to judge the dominance of either trade constraints or savings constraints. The indicators used are of two kinds: evidence of pressure on the limiting factor (e.g., falling exchange reserves, import rationing, rising interest rates) and existence of slack in the relation that is not binding (e.g., rising exchange reserves, liberalized imports, falling savings rates, slack capital markets, excess capacity). While our analysis is by no means exhaustive, a third of the 20 countries examined showed evidence of predominant trade limitations and another third of predominant savings limitations. More satisfactory diagnosis requires detailed country studies, which have tended to verify the importance of the trade limitation in several cases [10] [12] [13].

Fei and Ranis are quite right to emphasize (as we did) that standard econometric procedures imply equilibrium and can only be applied to estimate the constraints that are effective. It is therefore necessary to diagnose the limiting factors from additional information and to determine the savings, investment, and import functions from periods when they are not distorted by disequilibrium conditions. (Similar problems are encountered in allowing for excess capacity and underutilized labor when estimating full employment output in advanced countries.)

Our empirical analysis was designed to evaluate development performance and to produce estimates of aid requirements for a large number of countries

<sup>4</sup>The sharp transition from one phase or regime to another results from using linear models with linear constraints. While the mathematical conditions for turning points are suggestive of the factors which determine the shift, they hardly merit the stress given them by Fei and Ranis. In fact, our discussion of this topic in [4] was dropped from the *AER* version at the suggestion of the editor.

<sup>5</sup>Our problem is not unlike that of Fei and Ranis [9] in establishing the existence of a conventional floor to wages, which produces "surplus labor" and a departure from neo-classical equilibrium. In neither case does the need to use indirect methods of verification make the concept invalid or lacking in operational significance.



under alternative assumptions as to internal policies. It should be judged on those grounds. The estimation procedures have since been refined in [8] and [11] to make better allowance for the existence of disequilibrium during the period of observation. While the difficulties of estimation to which Fei and Ranis point are very real,<sup>6</sup> in our view the available evidence for many countries can be better interpreted on the basis of the two-gap hypothesis than by assuming optimal or equilibrium adjustments.

The search for stages of growth which has intrigued many economists (including our critics) can at best bring out uniformities in certain aspects of the development process. While our assumptions produced a fairly common phase sequence, we do not regard the properties of these projections to be more than suggestive of a possible development sequence—neither necessary nor optimal. While we are not so pessimistic as Fei and Ranis as to the possibility of detecting historical periods in which a given combination of constraints predominated, we would expect such studies to reveal a variety of sequences.

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<sup>6</sup>Fei and Ranis rightly point out that the two-gap model—like many others—does not contain formal criteria for identification. In order to estimate the values of the parameters, therefore, it is necessary to make use of additional information as to the binding constraints.

### A Paradox on Profits and Factor Prices: Comment

In a recent issue of this *Review* [1] Paul Meyer analyzed an interesting paradox of factor prices and short-run competitive profits and demonstrated that under certain conditions of supply and demand elasticity an increase in the price of a variable factor of production will lead to an increase in short-run profits. It was stated in the conclusion that "a corollary of the paradox is that profits no longer are a good signalling device . . . When the paradox holds, entry is encouraged though the number of firms in an industry is already larger than the industry can support in the long run" [1, p. 541]. This corollary is perhaps the most interesting part of the paper, for it certainly questions the consistency of the competitive model. It is the purpose of this note to point out that in the case Meyer described this corollary does not hold.

The best way to consider the corollary and to understand the paradox is to examine the dynamic process step by step. Let us consider the short run. Meyer demonstrated that an increase in a variable factor price leads to an upward shift in both the average variable cost and marginal cost curves. At every output, new average variable cost ( $AVC'$ ) is some number greater than unity—call it  $a$ —times old average variable cost ( $AVC$ ), and new marginal cost ( $MC'$ ) is  $a$  times old marginal cost ( $MC$ ). While the minimum points of  $AVC$  and  $AVC'$  occur at the same output, this is not true for the average total cost curves, for with no change in fixed cost, the output corresponding to minimum average total cost becomes smaller after the increase in variable factor cost than it was before.<sup>1</sup> This shifting to the left of the minimum point of the average total cost curve is responsible for the short-run profits noted in the paradox. If average total cost shifted upward only, short-run profits could not be earned.

The operation of the paradox is illustrated in Figure 1. Consider Meyer's example of a perfectly inelastic (pro rata) demand curve facing a competitive firm—a sufficient but not necessary condition for the paradox to hold. The firm is initially in equilibrium, selling at price  $P_0$  and earning a normal return. An increase in the cost of a variable factor raises  $AVC$  to  $AVC'$ ,  $MC$  to  $MC'$ , and  $ATC$  to  $ATC'$ . Since  $X_2$  is smaller than  $X_1$ , the firm now earns a short-run economic profit, selling at price  $P_1$ . Should market demand be less than perfectly inelastic, output of the industry would decrease with an increase in factor cost, but short-run profits will be earned only if the

<sup>1</sup> This may be proven as follows:

$$\begin{aligned}
 (1) \quad ATC &= \frac{C(X)}{X} + \frac{K}{X} & (1') \quad ATC' &= a \left( \frac{C(X)}{X} \right) + \frac{K}{X} \\
 (2) \quad \frac{dATC}{dX} &= \frac{XC_x - C(X)}{X^2} + \frac{-K}{X^2} = 0 & (2') \quad \frac{dATC'}{dX} &= a \left( \frac{XC_x - C(X)}{X^2} \right) + \frac{-K}{X^2} = 0 \\
 (3) \quad \text{Solving, } X_1 &= \frac{C(X)}{C_x} + \frac{K}{C_x} & (3') \quad \text{Solving, } X_2 &= \frac{C(X)}{C_x} + \frac{K}{aC_x}
 \end{aligned}$$

Therefore  $X_1 > X_2$ , since  $a > 1$ .

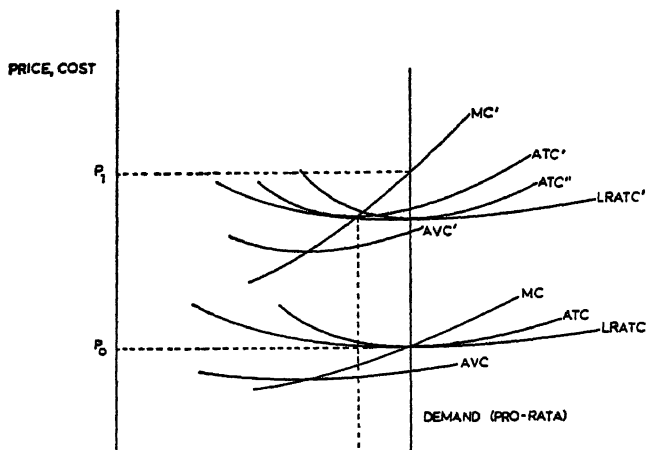


FIGURE 1

output corresponding to minimum average total cost has decreased relatively more than output of the industry.

Let us now consider the long run and grant in addition Meyer's assumption that "... firm's isoquants are homothetic with respect to their origins ..." [1, p. 541].<sup>3</sup> In such a situation an increase in a variable factor cost shifts  $LRATC$  (long-run average total cost) upward to  $LRATC'$ , and  $\min LRATC'$  occurs at the same output as  $\min LRATC$ . Under conditions where the paradox holds, short-run profits serve the appropriate function of signalling expansion for firms already in the industry rather than entry of new firms:  $\min ATC'$  is higher and occurs at a smaller output than  $\min LRATC'$ , and in order to reach long-run equilibrium, each firm will expand its scale of plant. When expansion of plant scale comes to an end, all economic profits will be wiped out, for then  $\text{Price} = \min ATC'' = \min LRATC'$ . If we make the normal assumption that potential entrants realize the long-run cost conditions, there will be no net entry, for new firms stand to make losses. That is, profits will be zero when all existing firms have adjusted their scale of plant, so the entry of any new firm would cause losses to prevail; such losses would, in turn, force some firms to leave the industry.<sup>4</sup> Potential entrants should be expected to recognize this situation and refrain from entering in the first place. In the case where demand is less than perfectly inelastic, some existing firms would have to leave the industry, because losses would prevail in the event that every firm tried to adjust its scale of plant to long-run equilibrium. But quite properly, each firm which

<sup>3</sup> It is important to note that homogeneous production functions of *any* degree have isoquants that are homothetic with respect to the origin.

<sup>4</sup> Long-run profits and losses are, of course, zero by definition under conditions of free entry and exit.

remained in the industry would adjust its scale of plant from  $ATC'$  to  $ATC''$  in response to short-run profits.

In conclusion, although Meyer's paradox suggests a number of important questions regarding the efficiency of short-run profits as a regulator of total industry investment, under the conditions which he describes, short-run profits serve the appropriate function of signalling an increase in plant scale for firms which remain in the industry, while the expectation of profits or losses prevailing in case all firms adjusted scale of plant serves to regulate the (equilibrium) number of firms. In short, Meyer's corollary that profits no longer are a good signalling device is not valid.

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\* The author is a graduate student in economics at the University of Virginia. The author wishes to thank Professors G. Warren Nutter, Roger P. Sherman, and Thomas D. Willett for helpful comments on an earlier draft of this note.

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### A Paradox on Profits and Factor Prices: Comment

According to an interesting paradox discovered by R. R. Nelson [2] and rediscovered (and extended) by P. A. Meyer [1], an increase in the price of one factor of production can, in the short run, lead to an increase in the profits of a competitive industry. The rise in costs can induce a reduction in output sufficient to raise product price by more than average variable cost.

Meyer concludes that the paradox depends on a variety of complex conditions. He states that profits respond positively to a factor-price change "when the absolute value of the ratio of demand elasticity to supply elasticity is less than the ratio of the share of all other productive factors to the share of the higher-price factor. . . . It is more likely that profits will increase (1) the smaller the share of the higher-priced input, (2) the more inelastic is demand, or (3) the more elastic is supply" [1, p. 539].

However, if the industry total-variable-cost function has the form  $TVC = gQ^a$  ( $a > 1$ ), the paradox will hold for any product-demand schedule of less than unitary elasticity, assuming the initial factor-price change causes a proportional shift in the cost functions. The result appears to be quite independent of the elasticity of the supply function (as represented by  $a$ ) and of the share of the price-rising factor in total cost.

A proof is relatively easy if factor supplies are infinitely elastic to the industry. Marginal cost will be  $agQ^{a-1}$ . At an initial output  $Q_1$ , with product price equal to  $MC$ , total revenue will be  $agQ_1^a$ , total variable cost will be  $gQ_1^a$ , and gross profit ( $= TR - TVC$ ) will be  $(a - 1)gQ_1^a$ .

Now we assume that an increase in a factor price causes the  $TVC$  func-

tion to rise by some proportion  $k$ ; thus

$$TVC' = gkQ^a, \text{ and } MC' = agkQ^{a-1}.$$

If product demand has less than unitary elasticity, industry output will move to an output  $Q_2$  at which total revenue will be greater than  $TR_1$ . Thus

$$agkQ_2^a > agQ_1^a$$

$$k > (Q_1/Q_2)^a$$

$$k(Q_2/Q_1)^a > 1.$$

Since

$$\pi_2/\pi_1 = \frac{k(a-1)gQ_2^a}{(a-1)gQ_1^a} = k(Q_2/Q_1)^a$$

$$\therefore \pi_2 > \pi_1.$$

The proof is more complicated if factor supply schedules to the industry are upward sloping, since industry marginal cost is then higher than marginal cost as perceived by the firm. If factor supply elasticities are constant, however, a constant proportionality holds between industry marginal cost and product price, and the same sort of proof can be used.

If the population of firms is constant and each firm has a production function in the form  $Q = X^a Y^b$ , where  $X$  and  $Y$  are variable inputs and their exponents  $a$  and  $b$  are positive fractions summing to less than unity, the paradox will result if product demand is inelastic.

In addition to the factors cited by Meyer, the range of the paradox may be affected by opportunities for substitution among variable inputs and by factor-supply elasticities to the industry.

## II

Meyer raises the disturbing possibility that, if increase in a factor price raises profits, "profits no longer are a good signalling device. . . . When the paradox holds, entry is encouraged though the number of firms in an industry is already larger than the industry can support in the long run" [2, p. 541].

Ambiguity arises from the complex relation between the adjustment of industry output and of the employment of the (formerly) fixed factor (which we assume represents capital). After existing firms make their short-run adjustments to a rise in  $P_T$ , industry output is too small, for product price will have risen above the new minimum  $LAC$ . Figure 1 illustrates the adjustment by the individual firm. The increase in  $P_T$  has not merely shifted  $SMC$  and  $SAC$  upward; it has also moved the minimum-cost-output point of the currently relevant  $SAC$  to the left. The average-cost-minimizing output  $q_m$  with the existing stock of fixed assets is now smaller than before. This permits each of the existing firms to operate at an output  $q_2$

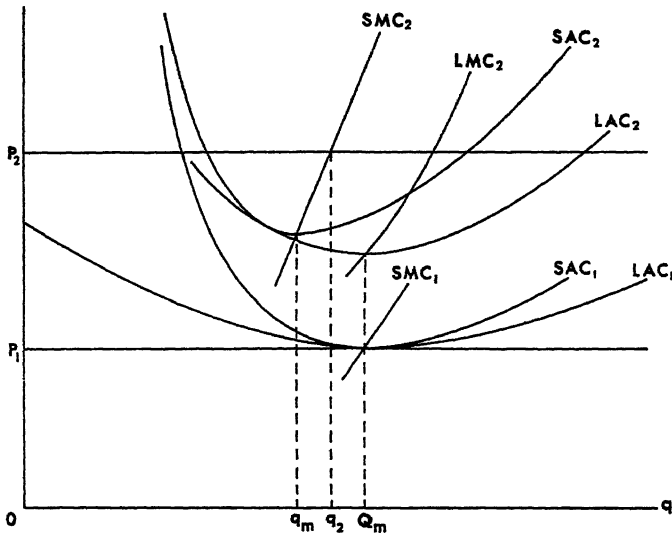


FIGURE 1

which is larger than  $q_m$ , but smaller than its original output  $Q_m$  at which  $LAC$  was minimized.

The existing firms find that their  $LAC$ 's have shifted upward, but without change in  $Q_m$ . Assuming no further changes in input prices, the long-run competitive equilibrium price for the industry is equal to the value of each firm's  $LAC$  at output  $Q_m$ , and that value is below  $P_2$ . Thus the industry's long-run equilibrium output is greater than the short-run output ( $\sum q_2$ ) being produced at price  $P_2$ .

Thus a signal to attract entry arises in a situation where industry output is too small. But entry is not necessary to correct the shortfall. For each of the existing firms is also producing below its long-run desired output, that at which  $LMC = P$ . Adjustment of output by existing firms would be sufficient to eliminate the shortfall in industry output and to drive price below minimum  $LAC$ . Entry will exacerbate this tendency.

The temporary rise in industry profits is also a signal that in some sense more capital is needed in the industry. The increase in price of a variable factor has increased the optimum amount of capital per unit of output for the industry. If the long-run optimum-output-size of firm is constant, the appropriate amount of capital per firm is also increased. Neither of these adjustments requires entry, but the signal which reflects the need for these adjustments tends to stimulate entry.

It is entirely possible that the appropriate stock of capital for the industry as a whole is increased, even though industry long-run-equilibrium output is reduced. This combination can result if the substitution effect of the increased variable-factor-price predominates over the output effect.

Therefore, the signal which attracts entry may reflect circumstances where both industry output and industry capital are too small. But entry is not necessary to meet the need for increased industry capital, any more than to eliminate the shortfall in output. Existing firms will remedy the one in the same process by which they remedy the other. Indeed, it is by adding to their capital that existing firms move their output toward the point where  $LMC = P$ .

The point at which entry signals are being most visibly flashed is thus a point of double disequilibrium. Industry output is deficient, and perhaps so is industry capital. But each existing firm's output is even more deficient, and so is its capital. Resolution of their particular disequilibrium by existing firms will be more than sufficient to eliminate the industry disequilibrium, or rather convert it into one of an opposite sort.

Existence of a homothetic production function, in which the (long-run) least-average-cost output of the firm is not altered by shifts in factor prices, produces misleading signals even in situations more conventional than those identified by Meyer and Nelson.<sup>1</sup> The assumption of homotheticity implies that all long-run equilibrium adjustments in industry output occur through changes in the number of firms, while the output-size of each remains constant. Yet almost every stimulus to output change provides an incentive, however temporary, for the individual firm to change both its output and its stock of durable assets. However, the equilibrium stock of durable assets of the individual firm changes only when relative input prices change.

That paradoxical adjustments result from homotheticity can be illustrated by a possible response to an initial decrease in the wage rate. Assume the cost-and-demand conditions for the Nelson-Meyer paradox are not present, so the lower costs increase both output and industry profits. Existing firms may have an incentive to add to their capital in order to expand output. Yet such additions are misguided. Entry of new firms will eventually drive product price down to equality with average cost and restore each "old" firm to its original output. And at the original output for the individual firm the appropriate quantity of fixed assets is less than the original endowment. The initial signals head the existing firms toward an excessive increase in capital, and perhaps toward inappropriate forms of capital as well.

Correspondingly, demand shifts may lead each existing firm to change its stock of durable assets in order to increase or decrease output. As long as relative factor prices remain unchanged, however, such changes are inappropriate.

The signals are misleading in failing to discriminate between adjustments better made by changes in the number of firms and those better made by

<sup>1</sup> Such a case may not seem plausible a priori, but it can be constructed mathematically. For pedagogical purposes, a specific production function having such properties is expressed by

$$X^{1/2}Y^{1/2} = Q^{1/2} - 0.2 Q^{1/2} + 0.01 Q^2$$

where  $X$  and  $Y$  are the quantities of two inputs and  $Q$  represents the quantity of output. The least-cost output of approximately 10.7 units is invariant with changes in input prices.

changing inputs and outputs of existing firms. Ambiguity inheres in the assumption that factor efficiency depends on the size of individual firms, an assumption implied by the U-shaped *LAC* curve and particularly inherent in the homothetic production function.

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\* The author is professor of economics at Miami University. He would like to thank his colleague, Professor D. A. Walker, for extensive assistance.

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### A Paradox on Profits and Factor Prices: Reply

What I thought was a clearly stated corollary of the higher wage rate-profits paradox may have been on reflection a somewhat cryptic concluding paragraph to my paper [4], particularly in view of Miller's and Trescott's Comments. However, before discussing in Sections II and III the role of profits as an entry and capital expansion signal, which is the main thrust of the Comments, let me briefly dispose of Trescott's Section I.

#### I

It was shown that profits are positively related to the wage rate when

$$(1) \quad \eta_D / \eta_S < (1 - \beta) / \beta,$$

where  $\eta_D$  is the elasticity of product demand;  $\eta_S$ , the elasticity of short-run supply;  $1 - \beta$ , the revenue share of capital; and  $\beta$ , labor's share<sup>1</sup> [4, p. 539]. Trescott correctly states that, if the industry total-variable-cost function has the form  $TVC = gQ^a$  ( $a > 1$ ), the paradox holds when demand is inelastic. Unless I misunderstand the purpose of Trescott's Section I and the imper-spicious statement that this result is *independent* of the elasticity of supply and factors' shares, Trescott offers the example to show (1) is incorrect. His analysis is confounded, however, by mistaking the elasticity of total variable costs for the elasticity of supply. Using usual notation,  $MC = dTVC/dQ = agQ^{a-1}$ , and by definition  $\eta_S = MC \cdot dQ/Q \cdot dMC = 1/(a-1)$ , not  $a$  as Trescott claims.<sup>2</sup> Since  $P = MC$  at equilibrium,  $TR = agQ^a$ . Labor's share, as denoted by  $\beta$  in (1), is  $TVC/TR = 1/a$ , and capital's share,  $1 - \beta$ ,

<sup>1</sup> For simplicity, we follow Trescott and assume only two factors, labor and the fixed factor, capital. While the manipulations required to get (1) originally led me to consider  $\eta_D$  with its appropriate algebraic sign, in (1)  $\eta_D$  is positive as usually defined.

<sup>2</sup> Moreover, Trescott does not realize that his first and second examples are identical since a production function of the form  $Q = X^a F^b$  ( $a + b < 1$ ) implies a total-variable-cost function of the form  $TVC = kQ^c$  ( $c > 1$ ).



equals  $(\alpha-1)/\alpha$ . It clearly follows that  $TVC = gQ^\alpha (\alpha > 1)$  implies a supply elasticity and factors' shares such that any inelastic demand schedule satisfies inequality (1).

## II

It may be best to state first the assumptions and then summarize my original paragraph on the role of profits as an entry signal. It is assumed that (1) a partial equilibrium analysis is appropriate, (2) all existing firms and potential entrants have identical U-shaped average cost curves, (3) the competitive industry has no external economies, and (4) free entry and exit are possible. A "correct" signal or rule suggests an increase (decrease) in a variable only if the current value of the variable is less (greater) than the long-run equilibrium value. Alternatively,  $x$  is a correct signal for  $y$  if for any parameter  $\alpha$ ,  $dx/d\alpha$  and  $dy/d\alpha$  always have the same sign, where  $dy$  is the long-run change in  $y$ .<sup>3</sup> While one may object to this definition of a correct signal, until better dynamic theories are developed I remain unconvinced that another definition would be more appropriate. In any case this definition was implicit in my paper, and Trescott and Miller seem to accept it.

Assume the industry is initially in long-run equilibrium. A higher wage rate raises  $LRAC$  and reduces long-run industry output, assuming demand is not perfectly inelastic. If firms' isoquants are homothetic with respect to the origin, optimum firm size, as determined by the output minimizing  $LRAC$ , is independent of factor prices.<sup>4</sup> Consequently, in the homothetic case the initial number of firms is greater than the number at the new equilibrium, and the reduction in industry output must be accomplished by the exit of firms. Since a homothetic production function does not preclude the higher wage rate-profits paradox, the corollary of the paradox is that profits are not a good entry (of firms) signal, by definition.

Miller appears to find the profits-entry corollary empty or even misleading because according to him the normal assumption is that potential entrants realize the long-run cost conditions of the firm and industry and do not respond to profits. Apparently the "normal" assumption is that potential entrants estimate industry demand at min  $LRAC$ , divide that output by the output minimizing a firm's  $LRAC$  in order to determine the long-run number of firms, and enter the industry only if the existing number of firms is less than the long-run number. Competitive firms may well behave as Miller suggests, though I personally doubt it. Be that as it may, the important point is that the long-run competitive model of most economists does *not* make the logical deduction drawn from Miller's "normal" assumption, i.e., entry never occurs when there is a surplus of firms compared to the

<sup>3</sup> The definition gives a necessary but not sufficient condition for a correct signal. The definition is similar in spirit to Modigliani's [5, p. 225].

<sup>4</sup> Isoquants are homothetic if the ratio of the marginal products is a function of the capital/labor ratio. As Miller states, all homogeneous functions are homothetic, but the converse is not true. Any monotonic transformation of a homogeneous function is a homothetic function.

long run.<sup>5</sup> Rather an examination of numerous price theory texts indicates the normal assumption is that potential entrants respond to profits. For example, Leftwich states, "The firm is making pure profits. It pay a greater rate of return to its investors than they can earn elsewhere; hence new investors and new firms will be attracted into the industry" [3, p. 169]. Trescott agrees that profits are the normal entry signal in the competitive model.

Though Miller mistakes the entry signal normally assumed in the competitive model, he does provide a good, if tautological, entry decision rule. Having stated a good rule, can one conclude as Miller does that my statement on profits as a poor entry rule is incorrect? He is guilty of a *non sequitur*.

### III

Besides its alleged role as an entry signal, returns (profits or losses) generally are acknowledged to indicate the desirability of capital expansion in some sense. Since we are assuming U-shaped LRAC curves, long-run equilibrium requires a unique distribution of the capital stock among firms. Alternatively stated, with identical firms the capital stock in the industry,  $K$ , equals the product of  $k$ , the capital stock of a firm, and  $n$ , the number of firms. Some  $K = K_e$  is not a sufficient condition for equilibrium. Rather the necessary and sufficient condition is  $k = k_e$  and  $n = n_e$  so that  $K_e (= k_e n_e)$  is attained in a specific manner. Miller and Trescott again err in claiming that returns indicate the appropriateness of the capital stock of an existing firm. Letting subscript zero indicate current values, Miller and at times Trescott claim that profits ( $\Pi > 0$ ) are made if and only if  $k_0 < k_e$ , so profits are a good signal for expansion by existing firms. Conversely, they allege losses ( $\Pi < 0$ ) occur only when  $k_0 > k_e$ . Actually what returns do indicate is the relation between the current capital stock in the industry and the long-run quantity.<sup>6</sup>  $\Pi \geq 0$  if and only if  $K_0 \leq K_e$ . Moreover, returns indicate only the relation between  $K_0$  and  $K_e$  and not the relation between  $n_0$  and  $n_e$  and between  $k_0$  and  $k_e$ . Normally, however,  $K_0 \leq K_e$  as  $n_0 \leq n_e$ . Expansion of the capital stock in the industry by entry usually is desirable, and contraction is accompanied by exit. Since  $\Pi \geq 0$  only if  $K_0 \leq K_e$ , returns also would be a correct entry signal were  $K_0 \leq K_e$  only if  $n_0 \leq n_e$ . Precisely because  $K_0 \leq K_e$  as  $n_0 \geq n_e$  when the paradox holds, a corollary of the paradox is that returns are not a good entry signal. The following paragraphs demonstrate the validity of these assertions.

Few authors of price theory texts discuss the relation between factor prices and the output minimizing a firm's LRAC. However, Leftwich

<sup>5</sup> Without stating so henceforth, such words as "surplus" and "shortage" are used only when comparing current to long-run values.

<sup>6</sup> Trescott's statement that profits also indicate a shortage of industry output is obviously correct, regardless of the disturbance temporarily producing profits. Profits require a current price greater than SRAC, which is at least as great as min LRAC. Since long-run price equals min LRAC, it readily follows from the negative slope of the demand curve that profits indicate a shortage of industry output.

[3, pp. 189-90] states that min-LRAC-output is a positive function of the wage rate, while Clark Allen [1, pp. 206-8] "proves" a negative relationship by assuming fixed costs in the long run. Actually the relationship between min-LRAC-output and relative factor prices is, in general, indeterminate.<sup>7</sup> Of course, higher wages increase the capital/output ratio, but the output minimizing LRAC may increase or decrease. We prove this in the appendix and also show, as was originally stated, that, if the isoquants are homothetic to the origin, min-LRAC-output is independent of factor prices.

As a good first approximation, therefore, the capital stock of a firm is positively related to the relative wage rate, for to be otherwise would require a negative output effect sufficiently large to offset the substitution effect in favor of capital. The last sentence is true regardless of how the wage rate affects profits. Since Miller and Trescott claim that profits (losses) suggest the desirability of capital expansion (contraction) by existing firms, it is indeed fortunate that the paradox was discovered. Normally returns play the role ascribed by Miller and Trescott only when the paradox occurs. Even if a higher wage rate leads to losses, existing firms still have a larger capital requirement. Returns do not correctly signal the need for capital adjustments by existing firms.

Higher wages increase the capital/output ratio but reduce the output of the industry. As Mrs. Robinson proved years ago, the wage rate and capital requirement of an industry are negatively related when  $\sigma < \eta_D$ , where  $\sigma$  is the elasticity of substitution [6, p. 259]. From (1) and Mrs. Robinson's proof, returns are positively related and simultaneously the industry's capital requirement is negatively related to the wage rate, a possibility according to Trescott, when

$$(2) \quad \sigma < \eta_D < \eta_S(1 - \beta)/\beta.$$

However, assuming the industry started at long-run equilibrium, (2) cannot hold because  $\sigma = \eta_S(1 - \beta)/\beta$ , a result perhaps not immediately obvious but easily proved. Let  $X = X(L, K)$  be the production function;  $X$  followed by a subscript signify a partial derivative; and  $w$ ,  $r$ , and  $P$  indicate the wage rate, the price of capital, and product price respectively. As is well known, since at long-run equilibrium  $w = X_L P$  and  $r = X_K P$ , equality of costs and revenue implies that  $X = L X_L + K X_K$ . About min LRAC one may treat the production function as if it were linear homogeneous. Then  $\sigma$  takes the simpler form [2, p. 343]

$$(3) \quad \sigma = X_L X_K / X_{LK} X.$$

The ratio of factor shares becomes,

$$(4) \quad (1 - \beta)/\beta = K r / L w = K X_K / L X_L.$$

To determine the elasticity of short-run supply note that  $SRMC = w/X_L$

<sup>7</sup> The fact that higher wages must reduce the output minimizing SRAC is immaterial for the entry question.

and  $dSRMC/dX = -wX_{LL}/(X_L)^3$ . It follows from the definition of the elasticity of supply that  $\eta_S = -(X_L)^2/X_{LL}X$ . Since the production function exhibits "constant returns,"  $X_{LL} = -KX_{LK}/L$ . The elasticity of (short-run) supply then can alternatively be written in the form,

$$(5) \quad \eta_S = L(X_L)^2/X_{LK}XK.$$

The product of (4) and (5) equals (3), so (2) cannot hold. As the wage rate varies, the industry's capital requirement and returns must change in the same direction, i.e.,  $d\Pi/dw$  and  $dK/dw$  have the same signs. If higher wages lead to profits, a shortage of capital exists. Returns are a correct signal for capital adjustment by the industry.

Does it matter that profits are not a correct entry signal by definition when the paradox occurs? After all, entry necessarily implies an increase in the capital stock of the industry, which is desirable when the industry is profitable. The fact that profits may be a poor entry signal is of no consequence if firms' production functions are linear homogeneous (which by assumption is ruled out), or if capital is malleable. Indeed were production functions linear homogeneous, my definition of a good entry signal is meaningless since the long-run number of firms is indeterminate. Unlike when average costs are U-shaped, with constant costs the distribution among firms of the industry's capital stock is a matter of indifference. If capital is malleable among firms, a reshuffling of capital will correct without social cost a temporary misallocation of capital among firms. If neither linear homogeneity nor capital malleability exists, when the higher wage rate-profits paradox occurs, efficiency requires an increase in the industry's capital stock but not an increase in the number of firms.<sup>8</sup> Net capital expansion must proceed by the expansion of existing firms with a simultaneous exit of some firms. The signal for more capital fails to discriminate clearly between more capital in existing firms and more firms.

The distinction between entry and capital expansion signals is important even in the easier to analyze case of a demand shift. An increase in product demand temporarily enables profits to be realized by having increased the industry's output and capital requirement. Assuming no external economies the optimal (min-LRAC) output and capital stock of an individual firm is independent of product demand regardless of the form of the production function. In this case the signal for capital expansion in the industry is flashed while entry is desirable. In fact, with U-shaped cost curves and nonmalleable capital, efficiency requires that the increase in the industry's output and capital stock be accomplished only by entry. Similarly a decrease in demand produces losses and calls for capital contraction in the industry by exit.

Were an industry faced with a change in the supply price of capital, neither short-run marginal cost, output, nor price varies. As receipts are constant while SRATC (evaluated at new prices) is positively related to

<sup>8</sup> Though a dynamic theory has not been presented, what may seem like a strong statement is essentially correct.

the price of capital, returns are negatively related to the price of capital. Again returns are a correct signal for capital adjustment by the industry as  $d\Pi/dr < 0$  and a negatively sloped demand curve assures that  $dK/dr < 0$ . Unlike the previous cases, however, the adjustment in the industry's capital stock is accomplished both by the adjustment of existing firms and entry. Normally the equilibrium number of firms and the capital requirement of an individual firm are in turn negatively related to the price of capital. A lower supply price of capital leads to profits which only here need not discriminate between capital expansion by existing firms and entry because both are desirable.

In summary, profits are a correct signal for more capital in the industry. Profits do not discriminate clearly between the alternative methods of capital expansion, entry and expansion of existing firms. Except when the paradox occurs, efficiency requires that at least part of the industry's capital expansion be accomplished by entry. In the paradoxical case only existing firms should expand, and entry imposes a social loss. Thus a corollary of the paradox is that profits are not a correct entry signal.

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#### APPENDIX

The well-known conditions for minimizing average costs,  $\partial AC/\partial X = 0$ , are<sup>9</sup>

$$(1) \quad AC = MC; \quad \partial MC/\partial X > 0,$$

where  $AC = AC(X, w, r)$  and  $MC = MC(X, w, r)$ . From the first-order condition the output minimizing  $AC$  satisfies the equation  $X = X_{AC/MC}$ . To determine the change in min- $AC$ -output as the wage rate varies, differentiate  $X = X_{AC/MC}$  partially with respect to  $w$ .

$$(2) \quad \frac{\partial X}{\partial w} = \frac{MC \partial AC / \partial w - AC \partial MC / \partial w}{AC \partial MC / \partial X - MC \partial AC / \partial X + MC(MC - AC)/X}.$$

Since (2) is evaluated at (1), the denominator is positive. Thus

$$(2') \quad \partial X / \partial w \gtrless 0 \quad \text{as} \quad \partial AC / \partial w \gtrless \partial MC / \partial w.$$

Though  $AC = MC$  at min- $AC$ -output, it does not necessarily follow that  $\partial AC / \partial w = \partial MC / \partial w$  as  $\partial AC / \partial X \neq \partial MC / \partial X$ . Moreover,  $\partial AC / \partial w$  and  $\partial MC / \partial w$  may even have opposite signs for  $\partial AC / \partial w = L/X > 0$  while  $\partial MC / \partial w$  may be  $< 0$  [7, pp. 60 ff]. Without further restrictions it is impossible to state whether min- $AC$ -output increases, decreases, or remains unchanged as the wage rate varies.

If the production function is homothetic to the origin, min- $AC$ -output is

<sup>9</sup> In the appendix all costs are long-run costs.

independent of factor prices. In the homothetic case the ratio of the marginal products is homogeneous of degree zero so the expansion path is a straight line.<sup>10</sup> For example,  $X = LK^{\frac{1}{2}} + L^2K$  is homothetic. In this case the first-order condition for cost minimization of any output is

$$(3) \quad X_K/X_L = F(L/K) = r/w.$$

To show the independence of min-AC-output and factor prices, let  $L/K = L^*$ . Differentiating totally,

$$(4) \quad dL/dK = L^* + KdL^*/dK.$$

As  $-X_K/X_L$ , which from (3) equals  $-F(L^*)$ , is the derivative of  $L$  with respect to  $K$  holding  $X$  fixed, substituting  $-F(L^*)$  for  $dL/dK$  in (4) gives

$$(5) \quad -F(L^*) = L^* + KdL^*/dK.$$

Assuming  $-F(L^*) \neq L^*$ , separating and integrating (5) yields a solution of the form

$$(6) \quad K = \phi(L^*)C(X),$$

where the constant of integration is a function of  $X$ , which initially was held fixed. It readily follows from (6) that

$$(7) \quad L = L\phi(L^*)C(X)/K.$$

Since  $L^* = L/K$  by definition, and since  $F(L/K)$  in (3) is assumed to be monotonic,  $L^* = F^{-1}(r/w)$ . Substituting for  $L^*$  in (6) and (7) one gets

$$(8) \quad \begin{aligned} K &= g_1(r/w)C(X), \\ L &= g_2(r/w)C(X), \end{aligned}$$

where  $g_1(r/w) = \phi(F^{-1}(r/w))$  and  $g_2(r/w) = F^{-1}(r/w)g_1(r/w)$ . In the homothetic case then  $AC$  and  $MC$  can be written as

$$(9) \quad \begin{aligned} AC &= (rK + wL)/X = C(X)[rg_1(r/w) + wg_2(r/w)]/X, \\ MC &= rK_X + wL_X = C'(X)[rg_1(r/w) + wg_2(r/w)], \end{aligned}$$

where  $C'(X)$  is  $dC(X)/dX$ . Differentiating (9) partially with respect to  $w$  shows that

$$(10) \quad XC'(X)\partial AC/\partial w = C(X)\partial MC/\partial w.$$

It is clear from (9) that the first order condition for minimizing  $AC$  is satisfied when  $XC'(X) = C(X)$ , so  $\partial AC/\partial w = \partial MC/\partial w$  at min-AC-output. Therefore, from (2') when the production function is homothetic, min-AC-output is independent of factor prices. In fact, one can make a stronger statement. Taking logarithms of (9) and differentiating partially with respect to either  $w$  or  $r$  shows that a change in relative factor prices shifts

<sup>10</sup> For a description of the properties of homothetic mappings, see any book on projective geometry.

every point of the cost curves by the same percentage. Moreover, the percentage change in costs with respect to output is independent of factor prices.

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### Full Employment Policy and Economic Growth: Comment

In a recent paper in this *Review* [4], R. R. Nelson examined the influence of an economy's potential growth rate, that is, the rate of labor force growth plus the rate of (labor-augmenting) technical progress, on the fiscal and monetary policies required for sustaining full employment growth. The question he posed was: "Is it true that if labor force growth or technical progress is more rapid, a more expansionary government policy is needed?" [4, p. 1181]. He answered that "the faster are technical progress or labor force growth, the tighter must be stabilization policy" [4, p. 1187]. In other words, the interest rate will be higher and/or the government surplus will be greater or the deficit smaller.

I wish to demonstrate in this note that Nelson's conclusion with regard to the stabilization role of fiscal policy requires an important qualification if savers' behavior is somewhat more "realistic" than the assumption of the constant saving-income ratio implies.<sup>1</sup> This assumption is a convenient one that has seen almost universal and sometimes indiscriminate adoptions in growth model analysis. I do not disparage its justifiable uses. However, I want to emphasize that the assumption might be inappropriate when wealth is recognized as an important variable. This is certainly the case when government deficits and, hence, public debt are explicitly considered.

Fiscal policy is applied in the long run to counterbalance the gap between investment and saving at full employment. The continuous saving-investment imbalance on the private accounts must reflect a more fundamental long-term disequilibrium between demand for and supply of assets in the private sector. This takes place when the adjustment mechanism fails either because the interest rate is inflexible or because the required rate of return is unresponsive to changes in the interest rate. While investment depends

<sup>1</sup> He was not unaware of such a possibility. There would have been no serious problem if a modification like this leads to no essential change in conclusions.

on the producers' desires to expand capital stock to meet expanding effective demand, private saving is determined by individuals' wishes to augment their wealth for various purposes. Just as there is the desired capital stock in investment planning, there would be conceptually the desired level of private wealth in consumer budgeting. If they are not equated automatically through the market mechanism, the excess or shortage of demand for assets must be absorbed through changes in the supply of public debt in order that full employment growth be sustained. This balance must be maintained along the long-term growth path. This argument points to the important position of the wealth variable.

Empirical evidence suggests that private saving is more responsive to the pace of economic growth than the constant-saving-ratio assumption implies. It is known that, when growth is more rapid, more saving tends to be called forth.<sup>2</sup> In other words, growth is self-accommodating to a certain extent. Postwar growth experiences of Western economies and Japan give this view a strong factual support. As we shall see below, this saving behavior can be accounted for by explicitly considering the effect of the wealth variable.

*Wealth-saving interaction.* The influence of wealth on private consumption and saving may be taken into account by a simple consumption function

$$(1) \quad C_t = a(1 - t)Y_t + bW_t, \quad 0 \leq a, b \leq 1$$

where  $C$  is private consumption,  $(1-t)Y$  disposable income ( $t$  is the tax rate), and  $W$  private wealth. This function is consistent with a number of consumer-behavior hypotheses.<sup>3</sup> The simplest way to derive it is to apply the stock adjustment principle to private saving. Assume that there is a certain ratio  $\omega$  that individuals want to establish between accumulated wealth and consumption.<sup>4</sup> Actual saving  $S$  is proportional to the gap between the desired and actual levels of wealth. Hence, we have

$$(2) \quad S_t = (1 - t)Y_t - C_t = \mu[\omega C_t - W_t], \quad 0 < \mu \leq 1$$

where  $\mu$  is the adjustment coefficient. Rewriting (2), we obtain

$$(3) \quad C_t = \frac{1}{1 + \omega\mu} (1 - t)Y_t + \frac{\mu}{1 + \omega\mu} W_t,$$

which corresponds to (1). It is easy to see from this that the saving ratio  $s (= S/(1-t)Y)$  is flexible in the short run. If income starts growing faster,  $s$  would rise.<sup>5</sup> Furthermore, this rise in the saving ratio is not only transient

<sup>2</sup> Otherwise, a higher growth potential would be dissipated largely as inflationary pressures. Forced savings through inflation have, I believe, only limited efficacy.

<sup>3</sup> In recent years, many writers proposed this type of a consumption function, though the underlying reasoning among them is different. See, e.g. [1] [2] [3, Ch 6] [6] [7].

<sup>4</sup> We assume that this relation holds for the household sector as a whole. Corporate saving is treated as part of private saving.

<sup>5</sup> This property of the growth response of saving is noted by the authors referred to above.



but also permanent. Noting that private saving increases wealth,<sup>6</sup> we can show that in the equilibrium growth situation the saving ratio converges to

$$(4) \quad s^* = \frac{\omega \gamma^*}{1 + \frac{\omega \mu}{\gamma^*} + 1}$$

where  $\gamma^*$  is the potential growth rate.<sup>7</sup> We can readily note that  $s^*$  is strongly responsive to  $\gamma^*$ . Indeed, there is no saving at zero growth. The rate of increase of  $s^*$ , however, diminishes as  $\gamma^*$  gets larger as can be seen from the derivative of (4), namely

$$(5) \quad \frac{ds^*}{d\gamma^*} = \frac{\omega}{\left[ \frac{1 + \omega \mu}{\mu} \gamma^* + 1 \right]^2}.$$

To simplify our analysis below, we assume that saving is perfectly responsive so that the desired level of wealth is always realized.<sup>8</sup> Then, (4) reduces to

$$(6) \quad s^* = \frac{\omega \gamma^*}{1 + (1 + \omega) \gamma^*}$$

*Long-run equilibrium condition.* For the production side, we assume that the capital-output ratio  $\kappa (= K/Y)$  is not affected by fiscal policy action so that we can take it as a given datum.<sup>9</sup> In addition, for simplicity, we assume

<sup>6</sup> We assume in this paper that the price level is constant. In other words, we disregard capital gains or losses due to price-level changes.

<sup>7</sup>  $\gamma^*$  is the sum of the growth rate of labor force and the rate of (labor-augmenting) technical progress, both of which are taken to be autonomous.

To derive (4), take the differential of (2), noting that  $S = \dot{W}$ . Then,

$$\dot{S} = \mu[\omega \dot{C} - S].$$

Divide it through by  $S$  to get

$$\frac{\dot{S}}{S} = \mu \left[ \omega \frac{\dot{C}}{C} \frac{C}{S} - 1 \right].$$

In equilibrium growth,  $\dot{S}/S = \dot{C}/C = \gamma^*$  and  $s = s^*$ . Hence,

$$\mu \left[ \omega \gamma^* \frac{1 - s^*}{s^*} - 1 \right],$$

which yields (4).

<sup>8</sup> We may note that some of the authors mentioned above assumed  $\mu = 1$ . See [2] [6].

<sup>9</sup> With a neoclassical production function, the capital-output ratio will be the ratio of the capital elasticity of output to the desired rate of return on capital, the latter being an increasing function of the rate of interest.  $\kappa$  will remain unchanged either because the market rate of interest is held constant or because the desired rate of return is insensitive to the rate of interest. We assume that one of these holds. We should also note that our model assumes that

that the desired capital stock is always realized. Then, dividing the  $IS$  equilibrium condition,  $I=S+(T-G)$ , through by  $Y$  ( $Y$  net output and  $I$  net investment), we get

$$(7) \quad \frac{I}{Y} = \frac{\dot{K}}{Y} = (1-t)s + (t-g)$$

where  $g$  is the share of government expenditure in national output. Along the long-term equilibrium path, it becomes

$$(8) \quad \kappa\gamma^* = (1-t)s^* + (t-g).$$

This is the basic growth equilibrium equation that must hold if the goods market is to be cleared at full employment production.

Before proceeding to examine (8), let us make some guesses about the parameter values. This provides a basis for checking the plausibility of our analysis. As regards the desired wealth-consumption ratio, we may refer to Spiro [6], whose finding suggests a historical value of about 5.2 in the United States. It is based on the estimated consumption function as well as direct, long-term observations of the wealth-consumption ratio derived from the well-known Goldsmith data. We adjust this ratio by excluding consumer durables and land from private wealth. Then, our estimate of  $\omega$  becomes about 4 or somewhat less. The same set of data indicates the capital stock-NNP ratio of 2 or somewhat above.<sup>10</sup> In spite of the rough nature of these estimates, there has no doubt been a substantial disparity between  $\omega$  and  $\kappa$  in the U.S. economy, which might be interpreted as suggesting an inherently oversaving tendency in that economy.

As a crude reflection of the U.S. experience in recent years, we may visualize a hypothetical economy in long-run equilibrium for our reference purpose. This economy is growing at 4 per cent per annum at sustained full employment. We assume  $\omega=4$  and  $\kappa=2$ . Hence, net investment is 8 per cent of NNP, while private saving is 14 per cent of disposable income. Assuming  $t=0.20$ , we find the following composition of national output:  $NNP=100$ ,  $C=69$ ,  $G=23$ ,  $I=8$ , and  $T=20$ . Correspondingly, we have  $K=200$ ,  $W=275$ , and public debt  $=W-K=75$ .

*The stabilization role of fiscal policy.* Let us first take up the tax rate  $t$  as the policy instrument while  $g$  is held constant. Substituting (6) into (8), we get

$$(9) \quad \kappa\gamma^* = (1-t) \frac{\omega\gamma^*}{1 + (1+\omega)\gamma^*} + t - g.$$

the desired rate of return is independent of tax policy. Income is completely distributed to households and the tax is identified with personal income tax. On these points, see the last footnote of the paper.

<sup>10</sup> Net capital stock consists of privately owned structures (including residential), producer durables, and inventories. Private wealth exceeds capital stock by the amounts of outstanding public debt, currency outside the Treasury, and net foreign assets.

Our analysis below is simplified by introducing a new variable

$$(10) \quad \delta^* = \frac{\gamma^*}{1 + \gamma^*}$$

$\delta^*$  is an increasing function of  $\gamma^*$ . Solving (9) for  $t$ , we obtain

$$(11) \quad t = \omega\kappa\delta^{*2} + (\kappa - (1 - g)\omega)\delta^* + g.$$

One can easily see how much change is required in the tax rate as the potential growth rate is increased if full employment growth is to be maintained. If we draw a graph with  $\delta^*$  on the horizontal axis and  $t$  on the vertical axis, (11) yields a parabola starting from  $t = g$  at  $\delta^* = 0$ . Differentiating (11) with respect to  $\delta^*$ , we get

$$(12) \quad \frac{dt}{d\delta^*} = \kappa(1 + 2\omega\delta^*) - (1 - g)\omega$$

so that

$$(13) \quad \frac{dt}{d\delta^*} > 0 \quad \text{as} \quad \delta^* = \bar{\delta}^* = \frac{(1 - g)\omega - \kappa}{2\omega\kappa}.$$

Thus, the parabola falls at first, reaches a minimum at  $\delta^* = \bar{\delta}^*$  and then keeps on rising as  $\delta^*$  increases. Hence, when the potential growth rate is low, a further increase of it will require that the tax rate be reduced, while when the growth rate is high, a further increase will require that the tax rate be raised. Nelson's prescription for the tighter stabilization policy with faster potential growth is acceptable only at growth rates higher than the critical growth rate  $\gamma^*$  ( $= \bar{\delta}^*/(1 - \bar{\delta}^*)$ ). In our hypothetical example ( $\omega = 4$ ,  $\kappa = 2$ , and  $g = 0.23$ ),  $\bar{\delta}^*$  is 6.75 per cent and  $\gamma^*$  7.24 per cent. What is important for our argument is that this cut-off rate of growth is not likely to be too low to make the former situation implausible. The tax rate is minimized at the cut-off rate.<sup>11</sup> It is easy to see that the government account will remain in deficit until  $\delta^*$  reaches  $2\bar{\delta}^*$  (or  $\gamma^* = 2\bar{\delta}^*/(1 - 2\bar{\delta}^*)$ ).

It is not difficult to explain why our conclusion differs from Nelson's. An increase in the growth rate requires a proportionate increase in investment if  $\kappa$  remains constant. If the saving ratio is also constant, the gap between the required investment and available private saving keeps widening as the growth rate rises. Hence, the gap must always be filled by the corresponding expansion of public saving, viz., the greater government surplus or the smaller deficit. A tighter stabilization policy, thus, follows. In Nelson's model,  $t$  must be increased by the same percentage points for a given percentage point increase of  $\gamma^*$  whether the economy is growing at low or high rates.

In contrast to this, if private saving responds positively to increases in

<sup>11</sup>  $t = g - \omega\kappa\gamma^{*2}$ . In our example,  $t = 0.194$ .

the growth rate, it is quite possible that saving increases faster than investment at lower growth rates where the response of saving is pronounced. However, saving responds to potential growth rates with diminishing force, while the responsiveness of investment remains unaffected. Eventually saving increases at a smaller rate than investment. Fiscal policy must be tightened only beyond this point. Moreover, our private savers and investors behave in such a way that there would be no net private saving and investment in the stationary state. Therefore, public saving must also be zero. With our given parameter values, individuals' saving tends to exceed capital accumulation at lower potential growth rates so that there must be public dissaving or government deficits in order to absorb this excess in the private accounts. The situation is reversed only at sufficiently high growth rates. As can readily be seen, the required changes in  $t$  are relatively large only at very low or high rates of potential growth. With moderate rates of growth (centering around  $\gamma^*$ ), such changes in  $t$  are small. In other words, fiscal policy will be active in one direction or another only when the economy is subject to the very weak or strong growth potential. In between, the private economy can take care of itself largely on its own. This observation certainly tallies with our intuitive conception of the stabilization role of fiscal policy in the process of economic growth.

One can, of course, use  $g$  instead of  $t$  as a policy instrument. Indeed, both  $g$  and  $t$  can be simultaneously altered to bring about the required adjustment as the potential growth rate is changed. In these cases, one finds very little difference from what we have studied above. In the former case, there is a certain critical growth rate, below which an increase in potential growth rates will require an increase in the share of government expenditure in national output and above which it will require a decrease in this share.<sup>12</sup> In the second case, suppose for instance that both  $t$  and  $g$  are changed by the same percentage points with  $t-g$  held fixed (the case of marginally balanced budget). One can see that they must be raised or lowered in response to an increase in  $\gamma^*$  according as  $\gamma^*$  is higher or lower than the cut-off rate specified by (13). As rises in  $t$  and  $g$  together are a loosening of fiscal policy, this result is consistent with our previous conclusion.<sup>13</sup>

Provided that the saving behavior of the private sector is influenced by wealth, our analysis has revealed that, as the economy's growth potential is improved (most likely through higher technical dynamism), fiscal policy must be more liberal at lower growth rates and more stringent at higher

<sup>12</sup> The cut-off rate of growth is determined by

$$\bar{\gamma}^* = \frac{-\kappa + \sqrt{\kappa\omega(1-t)}}{\kappa\omega},$$

which is 6.62 per cent for  $\omega=4$ ,  $\kappa=2$ , and  $t=0.20$ .  $\gamma^*$  is 7.09 per cent.

<sup>13</sup> Our analysis has been developed on a simplifying assumption of instantaneous adjustment of both saving and investment so as to attain the desired levels of stocks. When there are lags of adjustment, they reduce saving and investment flows. It is not hard to see that our cutoff growth rate will be lowered only if saving adjusts more sluggishly than investment.

rates. The switchover of policy between the two regimens is likely to take place at realistic rates of growth.<sup>14</sup>

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\* The author is an economist with the United Nations Secretariat. The views expressed in this paper are those of the author and do not purport to reflect those of the United Nations. He wishes to thank R. R. Nelson and the referee for comments on an earlier draft.

#### Costs of Medical Treatment: Comment

The Consumer Price Index provides an approximation to the money income adjustment necessary to maintain an individual at a constant level of utility (or, more loosely, to keep real income constant). Anne Scitovsky [1], in comparing the costs of treating certain medical problems in 1964-65 with those in 1951-52, arrives at results conceptually superior to those currently employed for the CPI, since the latter are based on prices of medical inputs

<sup>14</sup> We briefly consider important neglected factors that may affect our conclusion. An increased government deficit leads to an increase in public debt relative to output, which may depress the market rate of interest (on this, see [8]). It will then raise the capital-output ratio. Then the cutoff rate of growth  $\bar{\gamma}^*$  will be lowered. For this influence to be noticeable, however, (1) the market rate of interest must be sensitive to the relative volume of outstanding public debt and (2) the desired rate of return on capital must be responsive to the rate of interest. There are some grounds for doubting them. More important in this context is the incidence of tax policy. When firms are decision-making units independent of households (as they actually are) with part of tax collected at the source of income (i.e., in the form of the profits tax), the desired rate of return on capital determining the capital-output ratio is gross of the profits tax. When the profits tax rate is raised, the capital-output ratio will be lowered if the firms wish to realize a given net rate of return on capital. (On some empirical evidence supporting this thesis, see Sato [5]). Hence, a lowering of the tax rate (esp. the profits tax rate) in the face of a rise of  $\gamma^*$  will raise  $\kappa$  so that a lowering of  $\bar{\gamma}^*$  will result. Finally, it is also necessary to consider how the private demand for wealth is influenced by changes in the interest and tax rates.

such as hospital care and physicians' rates while Mrs. Scitovsky concentrates on the price of medical output.

Still, Mrs. Scitovsky's results are not entirely satisfactory. She argues that, for purposes of the cost of living index, quality changes in treatment should be ignored on the ground that while "the fact that the present treatment is better will increase his [the consumer's] welfare; it still leaves him with the problem of how to pay for it" [1, p. 195]. She does not recognize that, since the objective in constructing the index is to maintain welfare constant, the consumer should reduce the amounts purchased of other commodities and such reductions may provide the means to pay for the superior medical treatment. Since usually the consumer had the choice of both kinds of treatment in both periods it is improper to argue, as Mrs. Scitovsky does, that the substitution was "forced." In fact, the evidence cited in Mrs. Scitovsky's paper supports the hypothesis that such quality changes were the result of a change in demand. The fee for treating a forearm fracture was higher in both periods when done by a specialist (orthopedic surgeon) than by a general practitioner. Between 1951-52 and 1964-65 the percentage of cases treated by orthopedic surgeons increased from 60 to 89. At the same time the fee differentials increased from 75 to 100 per cent [1, p. 189]. This is clearly consistent with a shift in demand along a supply curve and not with a shift in supply along a demand curve. So the claim of "forced substitution" cannot be accepted.

There is a more fundamental problem with Mrs. Scitovsky's approach. Even if, following Mrs. Scitovsky, one restricts the definition of medical cost to pecuniary payments to conventionally defined medical inputs,<sup>1</sup> one cost element is missing. If a fractured hand is not set properly, additional treatment may be necessary at some future date. This is a type of medical cost not accounted for by Mrs. Scitovsky. Similarly, when considering maternity care one should recognize that a change in the frequency of miscarriages constitutes an effective change in the cost of maternity care.

More generally, one should ask in the beginning of a period what is the *expected* total cost of an illness. This should include the total cost of the illness if it occurs, multiplied by the probability that it will occur. The importance of the last element is dramatized by the case of polio. It is possible that the cost of treating a case of polio did increase by a factor similar to that indicated for the illnesses studied by Mrs. Scitovsky. It is perfectly clear, however, that the total cost of polio has dropped drastically since its incidence has been sharply curtailed by polio vaccine.<sup>2</sup>

In summary, it is the contention of this comment that in constructing the price index of medical services, an approach more comprehensive than Mrs.

<sup>1</sup> Even income tax authorities are more "liberal" since they take into account the income loss due to illness. Ideally one should account also for psychic costs, for children's and housewives' lost time, etc.

<sup>2</sup> In this comparison, vaccination costs should not be ignored. It should be pointed out that they can be incorporated quite readily in the present analysis, but it is hard to see how Scitovsky would account for them.

Scitovsky's has to be adopted. The cost of an illness will fall drastically if the illness is not allowed to develop and this genuine fall in medical cost should be included in constructing the index. Similarly, improvement in the quality of medical treatment should be adjusted for when the price index is calculated.

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1. A. A. SCITOVSKY, "Changes in the Costs of Treatment of Selected Illnesses, 1951-65," *Am. Econ. Rev.*, Dec. 1967, 57, 1182-95.

### Costs of Medical Treatment: Reply

1. Barzel argues that the substitution of treatment by specialists for treatment by nonspecialists has been the result of demand and hence cannot be termed "forced." He cites as evidence my own data on the treatment of forearm fractures which, while showing an increase in the use of specialists, give the appearance that the two forms of treatment (by specialists and nonspecialists) continued to exist side by side in 1965. I say "appearance" because in fact they existed side by side only in the simplest cases requiring a splint only (where treatment by specialists rose from zero to 31 per cent between 1951 and 1965), while in the more complicated cases requiring a reduction (with or without a general anesthetic), *all* cases were treated by specialists in 1965 as against only 40 per cent, resp. 30 per cent, in 1951. Furthermore, even in the splint-only cases, it was not so much the patient who chose the specialist as the nonspecialist who was no longer willing to treat the case. Specialization in medicine has become necessary as a result of the tremendous proliferation of medical knowledge, which makes it impossible for any one physician to master the whole field, much less keep up with the constant advances. In addition, legal considerations—i.e., the fear of malpractice suits—have played an extremely important role both in the increased use of specialists and in the increased use of diagnostic tests of all kinds. While I would not rule out demand as a factor since there are undoubtedly patients who choose a specialist of their own volition, I believe the primary reason for the increased use of specialists is physicians' reluctance, not to say unwillingness, to treat cases outside their special field.<sup>1</sup> In this sense, I believe I am justified in speaking of

<sup>1</sup> This view is supported by a recent study of medical care patterns under Group Health Insurance in the New York-New Jersey area [1, pp. 114-15]: "In evaluating patterns of specialist use by various population segments, it should be remembered that differences of apparent significance are not necessarily indicative of consumer choice. The fact that the use of surgical specialists increased sharply with age is less likely to be associated with the preference of older people than with types of surgery predominating at various age levels. Similarly, higher rates of specialist use in certain areas probably reflect local medical customs and facilities as much as individual residents' attitudes toward specialists. The occupation category of the subscriber was associated with the most consistent variations in use of specialists. Differences here *probably* reflect the exercise of consumer choice." (Italics added.)

"forced substitution." Similarly, I would also call the greatly increased use of laboratory tests, x-rays, intravenous solution for surgical patients, etc., "forced substitution" since I doubt if many physicians would omit a test or medical procedure at the request of a patient which they felt was necessary for proper diagnosis or treatment or which, if omitted, might leave them open to a charge of malpractice.

It is the higher cost of the admittedly higher quality care resulting from such "forced substitution" which I am arguing a medical care price index should not correct for. Conversely, I would not correct such an index for a decline in the quality of care when the patient has little if any choice. To cite an example mentioned in my article [3, footnote 3, pp. 1185-86], we found in our study that the rise in the average cost of treatment of otitis media was checked significantly by the reduction of home visits from 35 per cent of all physician visits in 1951 to 3 per cent in 1965;<sup>2</sup> if the percentage of home visits had remained unchanged, average costs of treatment would have risen by 105 per cent instead of the 68 per cent they actually rose.

2. I doubt that the problem of lower quality medical care resulting in the need for additional treatment in the future is very important in terms of dollars. Barzel's maternity care problem can be solved by comparing, not (as we did in our study) the costs of maternity cases terminating in live births in each of two years, but the costs of all pregnancies required to produce, say, 100 live births.<sup>3</sup> This would give us an index of the (medical) costs of production of a baby, which is a better index (since it refers to a better defined medical output) than the one used in our study.<sup>4</sup> If, as a result of higher quality care, the percentage of miscarriages was lowered in the later year, the resulting saving would offset to a greater or lesser extent the possible higher costs (higher fees of specialists, costs of additional tests, drugs, etc.) of the improved treatment.

3. I agree with Barzel that the type of improvement in the quality of medical care represented by the prevention or significant reduction in incidence of a particular disease as the result of the discovery of a vaccine (he cites the case of polio) should be reflected in a medical care price index. This can be done quite readily in a cost-per-episode-of-illness index (and in a conceptually more justifiable way than would be possible in the BLS medical care price index) by deflating the index in the later year when the illness has been prevented by the percentage of total consumer expenditures on medical care which the total costs of treatment of this illness accounted for in the base year, corrected by the estimated cost of the vaccine in the later year. In the

<sup>2</sup> Many physicians do not regard the substitution of office for home visits as a decline in the quality of medical care, arguing that an office visit makes possible a better diagnosis than does a home visit. I am inclined to believe that this possible advantage is more than offset by the greater inconvenience to the patient and the possible risk of less prompt diagnosis and treatment which an office visit may entail.

<sup>3</sup> In practice, this would require pricing the treatment of a series of consecutive maternity patients seen by a sample of physicians.

<sup>4</sup> This assumes, of course, that we are dealing with constant-quality babies; for the time being, I do not want to pursue this subject further, although I am sure that an improvement in the quality of babies could be taken into account too.



case of a vaccine giving lifelong protection, this cost would be the estimated depreciation and interest on total expenditures on the vaccine in that year. The rationale behind this procedure is that, except for the cost (as just defined) of the vaccine, prorated over the prevented cases, the average cost of the particular illness has fallen to zero. This procedure can, of course, be adapted to the situation where the vaccine, while not preventing the particular disease completely, has significantly reduced its incidence.

4. I have not attempted to take account of changes in indirect costs—i.e., the income loss due to illness, disability and premature death—because, as I stressed in my article, our study had very limited objectives [3, p. 1182]. I am not sure that this type of change can or should be reflected in a price index. Although in recent years we have had a variety of studies of the indirect costs of illness, it is apparent from the most recent of these studies [2] that reasonably accurate, consistent estimates of such costs could not be made frequently enough to be used in a price index. Nor, even if it were feasible, do I think they should be made that frequently. Except in the case of occasional dramatic breakthroughs, as in the case of polio and, probably much more important, the introduction of antibiotics, the effect of changes in medical practices and techniques on indirect costs is probably very gradual. Furthermore, the problem of changing indirect costs is not unique to the medical care component of the CPI and, while it may be more obvious, I am by no means sure that it is more important than in some of its other components. To be consistent, the CPI would also have to be corrected for the additional income resulting from the man-years gained for productivity by faster transportation and communication, labor-saving household appliances, and frozen and other prepared foods, to mention some of the more important examples. What we might want is a separate index, prepared every three or five years, of such gains due to improvements in the quality of medical care, additional labor saving devices in the home, and so forth, with which to evaluate and possibly correct the CPI.

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### The Role of Capital-Goods Trade in the Theory of International Trade: Comment

R. E. Baldwin has provided a valuable application of the Fisherian theory of interest to problems of trade and accumulation [1]. He proves that if there are two factors (labor and capital goods) and two products (capital goods

and consumption goods), all individuals have identical tastes, the fraction of each individual's income saved varies directly with the interest rate and is invariant with respect to the level of income, and the assumptions of P. A. Samuelson's interest rate equalization theorem [3] are met, two very interesting propositions hold. First, that, if the per capita capital stock is not equal in two countries, product trade cannot remove the incentive to capital movement from the rich to the poor country. This is a conclusion startlingly different from that of Samuelson. Secondly, that product trade will ultimately equalize per capita capital stocks between countries, and that trade will then cease.

Baldwin correctly points out that these results hold if an additional capital good is introduced as a produced factor; and that they cease to hold if a natural resource is introduced as an additional factor, even though a second consumption good is introduced so as to ensure that the number of factors does not exceed the number of products.

Baldwin, however, does not appreciate that, if an additional consumption good is introduced in his model, without a natural resource being introduced simultaneously as an additional factor of production, his results equally cease to hold. Suppose that there are two consumption goods (say cloth and food), which are tradeable, and that the capital good is either traded or is produced by each country to meet its own requirements. We retain all the other assumptions that Baldwin makes. In the current period, trading in cloth and food equalizes product prices, rentals and wages. In Baldwin's model, the expected rental in the next period associated with any given level of investment is that which would prevail if in that period only consumption goods are made. If the factor endowments of countries are sufficiently close, *entrepreneurs* will expect each country to make both cloth and food and to trade in the next period. They will therefore also expect that factor proportions in each industry will be the same in all countries, and that rentals will be equalized.<sup>1</sup>

Once the expected rentals are equalized between countries, so will the expected interest rates, as these interest rates equal the expected rental as a percentage of the current price of a capital good. There will thus be no incentive for international capital movement though per capita capital stocks are unequal. The same fraction of income will be saved in all countries. This process will be repeated from period to period until the expected interest rate declines to the level consistent with zero savings. At this stage per capita capital stocks need not be equalized. If the fractions of income devoted to cloth and food are the same whatever the level of income, the capital-rich countries will export the more capital-intensive of the two commodities; but if the income-elasticity of demand for the capital-intensive good is high, these countries may export the labor-intensive good.

Baldwin's results thus hinge crucially on the assumption that there is only one consumption good; it is this assumption which entails the conclusions that the expected interest rate must be lower in a capital-rich than in a capital-

<sup>1</sup> This does not happen in Baldwin's analysis where there is only one consumption good, because when it is expected that this good alone will be produced in each country in the next period it must also be expected that there will be no trade; and with unequal *per capita* capital stocks in different countries, rentals will be expected to vary between countries inversely with the levels of *per capita* capital stocks.

poor country, and that there is a unique level of the per capita capital stock consistent with zero savings.

Therefore Baldwin's model is an inadequate guide to a real world characterized by a multiplicity of consumption goods. It is thus not possible to agree with Baldwin when he concludes that, in view of the declining importance of natural resources as a source of comparative cost differences, per capita capital stocks will tend to be equalized between trading countries.

It may be emphasized that in Baldwin's model an incentive is left for funds to move between countries even when factor prices are equalized, because expected rates can diverge and are supposed to govern international flows of funds.<sup>2</sup> In contrast, in Samuelson's model, factor price equalization necessarily leads to interest rate equalization, as the interest rate is the current rental as a percentage of the current price of a capital good.

An important implication of the difference in the interest-theoretic assumptions of Baldwin and Samuelson is that, in Baldwin's model, the opening up of trade between a capital-rich and a capital-poor country may actually widen the gap between the rates at which investible funds are traded in these countries. With identical tastes, the pre-trade expected interest rate will be higher in the capital-poor country. Suppose that both countries make both goods when trade is opened up. If investment in each country remains at the pre-trade level, the price of capital goods will rise (fall) in the capital-rich (capital-poor) country. The rentals expected to prevail in each country in the next period do not change when trade is opened up, for entrepreneurs assume that in the next period both countries will make only the consumption good and that there will be no trade. The expected interest rate will therefore fall (rise) in the capital-rich (capital-poor) country. The level of investment may be reduced in the capital-rich country, and this will raise the expected interest rate; the cut in investment cannot however be so large as to restore the expected interest rate to the pre-trade level, if future consumption is not an inferior good. In the capital-poor country the level of investment will certainly be higher, as Baldwin points out; and while the expected interest rate may therefore fall below the pre-trade level, a rise in the expected interest rate due to trade being opened up is possible.

Finally, Baldwin's statements that 'trade models that follow the traditional assumption of excluding international movements of capital funds *invariably* (our italics) are set up entirely in static terms,' and that the possibility of net savings and hence of trade in capital goods is ruled out, require amendment. The present author has analyzed the effects of accumulation on the terms of trade when trade is balanced, taking trade in capital goods into account. [2].

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<sup>2</sup> Baldwin's *actual* interest rate is defined, on the other hand, as the rental in a period as a percentage of the price of a capital good in the previous period. As he points out correctly, factor price equalization will lead to the equalization of this actual interest rate; however, international capital flows are assumed to be governed by differences in expected rather than actual interest rates.

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### The Role of Capital-Goods Trade in the Theory of International Trade: Reply

Dr. Ramaswami's analysis of the case in which there are two consumption goods together with a single capital good and a given labor supply is a very useful expansion of my simple growth model. When complicating the commodity side of the model by introducing two consumption goods, I had also complicated the factor side by adding a natural resource factor. Since this gives each country fixed supplies of two immobile factors, the attainment of similar factor ratios is unlikely to be achieved no matter what the nature of the savings function is. However, as Ramaswami points out, if only the extra consumption good is added and the previous assumption concerning savings is retained, it is also possible to reach a stationary state in which factor ratios differ. It should be noted, however, that the savings assumption on which this conclusion rests is a very simple one. A more general assumption along Fisherian lines is that per capita savings are a positive function of both the interest rate and the level of per capita income. Under this assumption the stationary state position in the Ramaswami case is again one in which factor ratios are equal among countries, since with identical tastes among countries it is possible for interest rates to be equal and savings to be zero only when per capita incomes are identical.

Ramaswami also rightly points out that capital flows will not take place in the two consumption-goods case as long as "factor endowments of countries are sufficiently close." Capital movements actually will prevent the divergence between these endowments and thus per capital income levels from exceeding certain limits. For example, under the assumption that the savings fraction rises as per capita income increases, the initially richer nation in a two-country model will accumulate and grow at a faster rate. A point will eventually be reached where the capital-scarce country produces only the least capital-intensive of the three commodities. From that time-period onward, capital will flow from the capital-rich to the capital-poor country in order to prevent the marginal productivity of capital in the latter country from exceeding its level in the capital-rich country. In other words, as commodity trade alone fails to maintain interest equalization, capital flows take place and serve to reduce the per capita income disparity.

There are many other ways in which such a model can be usefully enriched. The nature of the possible paths toward equilibrium, which Ramaswami dis-

cusses and which Professor Leontief [1] also considered earlier, seems an especially interesting line to explore. The main point I wished to make in the original note and to reemphasize here is that trade models in which capital accumulation occurs and in which commodity-exchange involves both consumption and capital goods should replace the standard static models as the basic point of departure for analytical exercises in trade theory.

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### Rational Choice and the Patterns of Growth in a Monetary Economy: Comment

M. Sidrauski [1] claimed that: "in a growth model in which utility maximizing families are the basic economic unit of the system, the long-run capital stock of the economy is independent of the rate of monetary expansion. A rise in the rate of monetary expansion . . . does not affect steady state consumption." This conclusion seems to be at variance with the implications of my growth model [2] that: "the proportionate rate of growth of the money supply affects the long-run equilibrium capital intensity. A rise in the former will produce a permanent increase in the latter. In this manner the long-run marginal product of capital is negatively related, and the long-run real wage is positively related, to the proportionate rate of growth of the money supply." What accounts for the difference between us?

Our models differ in several respects. First, mine contains three assets: money, capital, and bonds whereas his contains two assets: money and capital. Second, I postulated independent saving and investment functions and assumed that investment plans are always realized. He followed the neoclassical nonmonetary tradition and assumed that saving and investment plans always coincide at every moment of time. Third, I assumed that the rate of price change is positively related to the excess demand for goods. He assumed that prices change so quickly as to produce a zero excess flow supply of money, or excess demand for goods, at every moment in time.

In this Comment I prove that the assumption of instantaneous adjustment is necessary for the conclusions of his model. The *attempt* by utility maximizing families to optimize over infinite horizons is not sufficient to produce monetary neutrality in long-run equilibrium. Were he to relax the assumption of instantaneous adjustment in the money market (or its dual, the commodity market) and allow the existence of forced saving, then nonneutrality would follow. This is not the only way to produce monetary nonneutrality in the long run. In my article [2, p. 462, note 12] I proved that one of two conditions is sufficient to produce monetary non-

neutrality in the long run: Either there must be a real balance effect in the savings function in long-run equilibrium<sup>1</sup> or it must be assumed that markets do not clear instantly. I shall confine myself to an examination of his model and indicate how the introduction of a finite speed of response and the existence of forced savings implies monetary nonneutrality within the context of his model. Deflationary periods will not be considered since they may not be compatible with the assumptions of full employment.

### I. *The Original Macro-economic Model<sup>2</sup>*

His macro-economic model consists of five equations which are reduced to two differential equations in  $k$  the ratio of capital to labor and  $\pi$  the expected proportionate rate of change of the price level. Let  $D$  be the operator  $d/dt$ . The first equation is the adaptive expectations equation (31) relating the expected to the actual proportionate rate of change of the price level  $Dp/p$ .

$$(31) \quad D\pi = b(Dp/p - \pi), \quad b > 0.$$

The quantity of real balances per worker  $M/pN$  is equal to the quantity demanded, where  $M$  is the stock of outside money,  $p$  is the price level and  $N$  is the size of the labor force. Along his derived optimal growth path, the quantity of real balances demanded per worker depends upon the ratio of capital to labor  $k$ , the proportionate rate of change of the money supply  $\theta$  and the expected proportionate rate of change of the price level  $\pi$ . Equation (38) states that the supply of, and demand for, a stock are equal.

$$(38) \quad \frac{M}{pN} = m(k, \theta, \pi)$$

$$(35) \quad \frac{DM}{M} = \theta \text{ constant,}$$

$$(36) \quad \frac{DN}{N} = n \text{ constant.}$$

A crucial equation accounting for the differences in our results is (38) or (39) which states that all markets are always in equilibrium in a monetary economy when prices are rising. By Walras' Law in a two-asset model, the excess demand for goods must equal the excess flow supply of money. Equation (39) implies that people are holding their desired stocks of money; and (38) implies that desired savings equal actual savings.

Aggregate demand per worker consists of investment per worker plus consumption per worker. The former is  $Dk + (u+n)k$  where  $u$  is the rate of

<sup>1</sup> Tobin [3] obtained nonneutrality by assuming that a real balance effect exists in the savings function. If the labor force in his model were constant, there would be no real balance effect in his savings function in equilibrium; and monetary neutrality would prevail. Although his model may be dynamically unstable, it can be made stable by introducing an adaptive expectations equation with a sufficiently low speed of adjustment.

<sup>2</sup> I use his notation and equation numbers. Variants of his equations have alphabetic suffixes. Other equations have alphabetic indexes.

depreciation and  $n$  is the growth of the labor force. Along his optimal growth path, the desired consumption per worker  $c$  is a function of  $k$ ,  $\pi$  and  $\theta$ . Specifically, in the neighborhood of equilibrium desired consumption per worker is:

$$c = c(k, \theta, \pi), c_k > 0, c_\theta > 0, c_\pi + c_\pi = 0.$$

Equation (39) states that actual capital formation is identically equal to output less planned consumption.

$$(39) \quad Dk = y(k) - (u + n)k - c(k, \theta, \pi).$$

Take the time derivative of (38) and use the adaptive expectations equation (31). Then, the equality between the supply of and demand for real balances per worker implies that:

$$(40) \quad \theta - \pi - n - \frac{1}{b} D\pi = \frac{m_k}{m} Dk + \frac{m_\pi}{m} D\pi.$$

If the dynamic system (39)–(40) is stable, then  $k$  converges to  $k^*$  and  $\pi$  converges to  $\pi^*$ . Then,  $Dk = D\pi = 0$  and long-run equilibrium is described by equations (A) and (B). The former is derived from (40) and the latter is derived from (39) and (A).

$$(A) \quad \pi^* = \theta - n$$

$$(B) \quad y(k^*) = (u + n)k^* + c(k^*, \theta, \theta - n).$$

Several conclusions follow. First, the proportionate rate of change of the expected price level is equal to the proportionate rate of change of the money supply per worker. Second, the actual and expected proportionate rate of change of the price level are equal. Since  $\pi$  is constant at  $\pi^* = \theta - n$ , the adaptive expectations equation implies that  $\pi^* = Dp/p$ . Third, monetary neutrality must prevail in long-run equilibrium since  $c_\theta + c_\pi = dc/d\theta = 0$  and no other term in (B) contains monetary variables. In long-run equilibrium, output per worker and consumption per worker are independent of the rate of monetary expansion.

## II. *The Effects of Allowing Forced Saving*

Suppose we use his micro-economic analysis to obtain demand functions, but assume that the money market (or its dual, the goods and services market) does not come into equilibrium instantly and forced savings are possible when prices are rising. Then, nonneutrality will be implied by the resulting model.

Families continue to have expectations of price changes and *desired* consumption along a family's optimal growth path is:<sup>3</sup>

\* Along an optimal growth path, the quantity demanded per worker of real consumption, real cash balances, and real capital are functions of the implicit price of consumption, the expected rate of price change, the rate of monetary transfers, and total asset holdings. We may therefore express the quantities *demand* per worker of real consumption and real cash balances as  $c = c(k, \theta, \pi)$  and  $m = m(k, \theta, \pi)$ . These equations are valid at all points on the optimum path and *express* quantities demanded. Condition  $c_\theta + c_\pi = 0$  is not valid at all points on the path.

$$c = c(k, \theta, \pi), \quad c_k > 0, \quad c_\theta > 0, \quad c_\pi < 0.$$

*Desired* real balances per worker, by the same analysis, is:

$$m = m(k, \theta, \pi), \quad m_k > 0, \quad m_\pi < 0.$$

Each family selects its desired  $c$  and  $m$  on the basis of the optimizing procedure described by Sidrauski. However, he is concerned with a monetary economy where price expectations are not held with certainty. This is the meaning of the adaptive expectations equation with a value of "b" sufficiently small to guarantee stability. Equation (39) excludes forced savings: a situation where people do not automatically save the desired amount. It seems incongruous to exclude forced savings from a monetary economy with adaptive expectations. The alternative to his procedure is to assume independent saving and investment functions and to examine the implications of this assumption for a growth model.

Assume that the proportionate rate of change of the price level  $Dp/p$  is proportional to excess aggregate demand per worker. The factor of proportionality  $\gamma$  is finite and strictly positive, and is the speed of adjustment in the goods and services market. By Walras' Law in a two-asset model, the excess demand for goods must equal the excess flow supply of real balances. Assume that the excess flow supply is proportional to the excess stock supply and is of the form:

$$h[\log M/pN - \log m(k, \theta, \pi)].$$

A variety of other forms would serve our purposes equally as well. Then, the equation determining the rate of price change is (38a). Portfolio balance is assumed to be the necessary and sufficient condition for price stability.

$$(38a) \quad \frac{Dp}{p} \frac{1}{\gamma} = h[\log M/pN - \log m(k, \theta, \pi)].$$

Sidrauski's (38) is a special case of (38a) when the speed of adjustment is infinite. The right-hand side of (38a) is desired investment per worker less desired savings per worker. "Disequilibrium" dynamics are explicitly stated in (38a); and the driving force behind inflation or deflation is the excess flow supply of, or demand for, real balances per worker.

Take the time derivative of (38a) and use the adaptive expectations equation (31). Equation (40a) is derived.

$$(40a) \quad \frac{1}{\gamma} \left[ \frac{D^2\pi}{b} + D\pi \right] = h \left[ \theta - \frac{D\pi}{b} - \pi - n - \frac{m_\pi}{m} D\pi - \frac{m_k}{m} Dk \right]$$

When  $\gamma$  is infinite (40a) implies Sidrauski's (40). Following him, suppose that the dynamic system is such that  $k$  converges to  $k^*$  and  $\pi$  converges to  $\pi^*$ . Then,  $Dk = D\pi = 0$  and equation (A) is again derived. Regardless of the speed of response in markets, in long-run equilibrium the expected rate of price change is equal to the growth of the money supply per worker. Given the adaptive expectations equation, the actual rate of price change  $Dp/p$  will be  $\theta - n$  in equilibrium.



The second equation is Walras' Law: The excess supply in all markets is always zero. Equation (38a) refers to the excess flow supply of real balances per worker. Hence, this excess flow supply is equal to the excess demand for goods per worker. Walras' Law is:

$$(39a) \quad \frac{1}{\gamma} \frac{Dp}{p} = \frac{I}{N} - \frac{S}{N}$$

where  $I/N$  is desired investment per worker and  $S/N$  is desired savings per worker. It is clear from (39a) that an infinite  $\gamma$  implies that *ex ante* savings and *ex ante* investment are always equal. Sidrauski's model is implied by an infinite  $\gamma$  and is a special case of (39a). In this formulation, inflation implies the simultaneous existence of excess aggregate demand and deflation implies the simultaneous existence of excess aggregate supply.

The outline of my proof concerning monetary nonneutrality can be presented very simply. In equilibrium, equation (A) must prevail. Substituting (A) into (39a) we obtain:

$$(39b) \quad \frac{\theta - n}{\gamma} = \frac{I}{N} - \frac{S}{N}$$

When the speed of response  $\gamma$  is finite, variations in the rate of monetary expansion per worker ( $\theta - n$ ) must produce corresponding changes in planned investment less planned savings per worker. If  $I$  and  $S$  were exclusively functions of  $k$ , then the capital labor ratio  $k$  must adjust to create the appropriate inflationary or deflationary gap. Monetary nonneutrality results in the long run. Implicitly Sidrauski assumes an infinite  $\gamma$ : planned savings and investment are brought into equality with a zero lag. Variations in  $\theta - n$  have no long-run effect upon  $I/N - S/N$ ; and monetary neutrality would prevail if  $I$  and  $S$  were functions only of real variables. A complete proof of these heuristic comments follows.

Assume that the actual rate of capital formation  $DK$  is a linear combination of desired savings and desired investment during inflationary periods. For example, when planned investment exceeds planned savings, there is both some forced saving and a frustration of some planned investment. This assumption is:

$$(C) \quad \frac{DK}{K} = \lambda \frac{I}{N} + (1 - \lambda) \frac{S}{N}, \quad \text{where } 1 > \lambda > 0 \quad \text{when } \frac{Dp}{p} > 0.$$

Substitute (39a) into (C) and obtain (D): an equation for actual investment per worker.

$$(D) \quad \frac{DK}{N} = \frac{\lambda}{\gamma} \frac{Dp}{p} + \frac{S}{N}$$

Desired savings per worker (in terms of the flow of output) is output per worker less planned consumption per worker:  $y(k) - c(k, \pi, \theta)$ . Actual investment per worker is:

$$(D1) \quad \frac{DK}{N} = \frac{\lambda}{\gamma} \frac{Dp}{p} + y(k) - c(k, \pi, \theta).$$

The identity relating the growth of the capital labor ratio  $Dk$  to actual investment per worker  $DK/N$  is:

$$(E) \quad Dk = \frac{DK}{N} - (u + n)k.$$

Substitute (D1) into (E) and obtain (E1).

$$(E1) \quad Dk = \frac{\lambda}{\gamma} \frac{Dp}{p} + y(k) - c(k, \pi, \theta) - (u + n)k.$$

Substitute the adaptive expectations equation into (E1) and derive (E2).

$$(E2) \quad Dk = \frac{\lambda}{\gamma} \left[ \frac{D\pi}{b} + \pi \right] + y(k) - c(k, \pi, \theta) - (u + n)k.$$

Equations (40a) and (E2) are the basic differential equations of my generalization of Sidrauski's model. The first equation is a behavioral one which states that the rate of price change is proportional to the excess flow supply of real balances per worker. Equation (E2) is based upon three relations: (1) Walras' Law states that the excess flow supply of real balances per worker is always equal to the excess demand for output per worker. (2) Actual investment per worker is a linear combination of planned investment and planned savings. (3) There is an identity between the change in the ratio of capital to labor and actual investment per worker. Deflationary periods are not considered, since the full employment assumption may be violated.

When the dynamic system containing (E2) is stable for fixed expectations (i.e., for a fixed  $\pi$ ) then in the neighborhood of equilibrium,

$$(F) \quad \frac{\partial(Dk)}{\partial k} = y'(k) - c_k - (u + n) < 0.$$

Displacements of  $k$  from the equilibrium tend to be corrected. Using stability condition (F), the long-run nonneutrality of money can be demonstrated for a positive value of  $(\lambda/\gamma)$ .

In long-run equilibrium  $Dk = D\pi = 0$  and the value of  $\pi$  is given by (A). Then equation (39c) is satisfied.

$$(39c) \quad \frac{\lambda}{\gamma} (\theta - n) = c(k^*, \theta, \theta - n) + (u + n)k^* - y(k^*).$$

When  $(\lambda/\gamma)$  is positive, then variations in the constant rate of monetary expansion will affect the long-run equilibrium capital intensity  $k^*$ . Differentiate (39c) with respect to  $\theta$  and solve for  $\partial k^*/\partial \theta$ . Equation (G) is derived: The final step in the proof.

$$(G) \quad \frac{\partial k^*}{\partial \theta} = \frac{(\lambda/\gamma) - (c_\theta + c_\pi)}{c_k + (u + n) - y'(k)}.$$

Stability requires that the denominator be positive (see F). Long-run monetary neutrality requires that the numerator be zero. In Sidrauski's model,  $\lambda/\gamma$  was implicitly zero and  $(c_\theta + c_\pi)$  was explicitly zero. Hence he found that the long-run capital intensity is independent of the rate of monetary expansion. When the speed of response  $\gamma$  is finite and forced savings can occur (i.e.,  $\lambda$  is positive), a very different conclusion emerges. Even if *desired* consumption per worker is independent of the rate of monetary expansion (i.e.,  $c_\theta + c_\pi = 0$ ), which is the most favorable case for Sidrauski, the rate of monetary expansion is not neutral in the long run. The value of  $\partial k^*/\partial \theta$  is strictly positive.

$$(G1) \quad \frac{\partial k^*}{\partial \theta} = \frac{\lambda}{\gamma[c_k + (u + n) - y'(k)]} > 0.$$

The argument concerning nonneutrality applies *a fortiori* to the case where  $c$  is affected by  $\theta$  in the long run.

A rise in the rate of monetary expansion will raise the long-run equilibrium capital intensity. This completes the proof that, even within the context of his model, the long-run equilibrium values of the real variables will be affected by the rate of monetary expansion when (1) there is a finite speed of response in the goods and services market, and (2) there is forced savings during inflationary periods. These conditions are sufficient to produce nonneutrality.

Price stability exists if, and only if, there is portfolio balance. When there is secular inflation, the rate of capital formation exceeds that desired by households. The time path of the capital stock in this single good economy only coincides with that desired by households when price level stability exists. The conclusion of this analysis is that it is not a matter of indifference to society, in either the short run or the long run, what proportionate rate of change in the money supply is chosen by the monetary authorities.

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## BOOK REVIEWS

### General Economics; Methodology

*Drafted or Deferred: Practices Past and Present.* By ALBERT A. BLUM. Ann Arbor: Graduate School of Business Administration, University of Michigan, 1967. Pp. xii, 275. \$8.00.

*Why the Draft? The Case for a Volunteer Army.* Edited by JAMES C. MILLER III, contributions by David B. Johnson, Cotton M. Lindsay, Mark V. Pauly, Joseph M. Scolnick, Jr., Robert D. Tollison, and Thomas D. Willett, with an Introduction by Senator Edward W. Brooke. Baltimore: Penguin, 1968. Pp. 197. \$1.25.

It is interesting to view these two books about the recruitment for armed forces as companion pieces. The first, by Albert A. Blum, is largely a historical account of the experience with selective service in World War II. It is well documented with government records and letters and memoranda from private files. While written in uncontroversial style, its sympathies readily become clear, as much by the questions not asked as by those considered. World War II was apparently a "good" war, and those who helped us prepare for it by giving us our first peace-time draft and those who tried to mold the regulations to the needs of winning the war were the good guys. There is little sympathy for the old-time isolationists who sought to limit our armed forces by taking up the cudgels for various special groups, including, particularly, fathers and farmers.

The book is a work of history; it contains no economic analysis. It may be interesting and instructive to those who wish nostalgically to recall what they were doing in the various agencies in Washington, particularly the Army, Navy, and War Manpower Commission, or to be told what was going on behind their backs while they were at the Front. The controversies among the regulators and their various agencies as they argued about how many and whom to draft and by whom and how deferments and even reassignments to civilian life were to be decided, are really something to contemplate. At one time, as a method for determining deferment of farmers, a "war unit system" was set up in which "taking care of one milk cow, for example, was counted as one unit and used as a basis for other measurements. Three beef cows, forty turkeys, five acres of corn, all were the equivalent of work with one milk cow. . . . In order to be deferred a farmer at first was supposed to work on 16 farm units; but the number of units changed often as result of political pressure" (pp. 77-78). A detailed table explained the number of animals or acres equal to one war unit for a wide variety of agricultural commodities, along with "conversion factors."

One does get a view of certain unfortunate practices such as appeals for deferments and even the assignment of soldiers for work where low wages or bad working conditions made the supply of labor inadequate. One also

saw the occasional use of the draft or threat to use it in efforts to break strikes. And one witnesses arguments in favor of universal military service, which would draft workers for nonmilitary activity as others were drafted for the Armed Forces, and counterarguments that this would be "undemocratic."

The question of pay or remuneration for servicemen as an inducement for entering the Armed Forces hardly comes up except in an epilogue dealing with the current situation, where high salaries are endorsed. It is perhaps interesting to note that among the original sponsors of conscription, the civilian group urged a token salary of \$5.00 a month for draftees; the military preferred equal pay for "all soldiers in the same grade" (p. 8).

Blum makes short shrift of volunteers. After pointing out that the Army and Navy in World War II attempted to limit voluntary inductions, he writes, "Volunteering for induction, like enlistments, proved to be a weak link in the chain of proper manpower mobilization during the war. It was easy and it appeared to be democratic. But volunteering during wartime is really an undemocratic way of mobilizing an army since it places the burdens of service unfairly on the most patriotic. It is also most disruptive to our economic life during wartime" (p. 100). Blum concludes, "when war disappears as an instrument of national policy, then the draft will disappear as an instrument of national manpower policy—but, unfortunately, not before" (p. 229).

*Why the Draft?* should have considerably greater appeal to economists. Put together, apparently hastily (by past and present University of Virginia students in economics and one in political science now generally beginning their academic careers), the work is in large part a polemic for extending the principles of a market economy to the recruitment of our Armed Forces. It has the recommendation of Milton Friedman, who is credited generally for many of the central ideas; and of John Kenneth Galbraith, to whom the jacket ascribes the quotation: "This fresh view is exceedingly welcome and I, for one, hope it will be highly influential." It should be, although it is a pity that further editing did not improve the work stylistically and remove shrill tones which will put off some readers.

The economic arguments are not generally original but they may well prove persuasive to many who face them with an open mind for the first time. Pauly and Willett, in the discussion of the burden of National Defense, make clear that conscription is a heavy implicit tax on draftees and "reluctant volunteers" who join the forces with the Draft Board breathing down their necks. This tax may be conceived as relating to both what the draftee sacrifices in actual remuneration as the result of lower pay in the Armed Forces than in civilian employment and to the money value of his sacrifice in being forced into military service if he would prefer to stay a civilian even if the remuneration for the two types of activity were the same. Citing figures of Walter Oi and Friedman, Pauly and Willett suggest the implicit tax based upon difference in pay as about 32 per cent and the total tax in the neighborhood of 50 per cent of civilian income.

There may be some question about these particular figures; military pay scales have been rising and special benefits including those in combat zones, broadly defined, are substantial. Further there is a conceptual problem. Pauly and Willett have followed others in relating the total tax to the difference between military pay and what it would take to induce an individual to volunteer for military service. Thus, with military pay, in their example, \$2,102 per year, civilian pay \$4,000 per year, and the amount necessary to induce voluntary enlistment \$5,000 per year, they calculate the effective tax rate as  $(\$5,000 \text{ minus } \$2,102) / \$4,000 = 72.5 \text{ per cent}$ . The difficulty is that this confounds an income effect involved in offering a draftee the pay necessary to induce him to volunteer with the correctly computed additional money tax on his \$4,000 of civilian income, which would leave him indifferent between (1) being drafted or (2) paying the tax but remaining a civilian. The latter measure would generally be less.

Whatever the precise measure, however, the authors are certainly correct that draftees and "reluctant volunteers" are victims of a substantial implicit tax, difficult to justify in terms of any principles of equitable taxation. Evidence for this, as the authors point out, may be found not only in the dearth of true volunteers at current remuneration, but in the arguments of supporters of the draft that turning to a volunteer system would prove "expensive," for the expense would reflect the cost now being met involuntarily by draftees. The economic advantages of a volunteer system of recruitment involve most of the advantages that economists know well are offered by freedom of choice within the framework of a market mechanism. With a volunteer system and a reasonably functioning market we need no longer be concerned with problems of deferment and exemptions. Those who have more to contribute in civilian life would presumably be receiving more in civilian life and would turn down the relatively poorer opportunities in the military. Those who prefer education to military service would be free to exercise that choice, subject only to the added taxes they or their parents might pay and the opportunity cost of military remuneration. The repugnant practice in a free society of prying into individuals' beliefs to find out if they are "truly" conscientious objectors could be eliminated as the conscientious objectors too would have to pay the price of their choice, however principled, only in terms of foregone military earnings and the taxes for the military forces which their country maintains.

And there would be gains for the Armed Forces themselves. They would have employees who preferred the work. Discharge would become a sanction readily applicable for unsatisfactory performance, rather than a sought-for escape. They would be better guided in rational use of their own resources, recognizing the true cost of manpower, and hence less likely to squander it in make-work or foolish use of skilled labor. They might also expect, with better pay and the better working conditions they would be induced to provide in their competition with any other employer, much greater re-enlistments and hence use of trained personnel rather than allocation of a great deal of time and effort to training of recruits.

On the political decision-making level, a volunteer system might have some substantial advantages. Many opponents of the war in Viet Nam may properly blame its long duration on the fact that its true cost was understated, in considerable part because of failure to measure the implicit tax paid by conscripts, and, what is worse, met largely by the relatively poor and young and politically uninfluential, rather than the main body of older and wealthier middle and upper classes who might have put a stop to it if they had been forced to meet the cost themselves. It might have been sooner than February 23, 1968 that the *Wall Street Journal* would have questioned the value of remaining in Viet Nam and warned "the Administration . . . to recognize that no battle and no war is worth any price, no matter how ruinous."

Other sections of the book are uneven but tell an interesting story. One may be particularly impressed by Scolnick's account of the experiences of Britain and Canada with volunteer Armed Services, arguing that other countries with language and political institutions common to our own have found volunteer forces generally preferable. The chapters by Lindsay, indicating the general reliance on volunteer forces through almost all of our history until World War I, are particularly striking. Most noteworthy are the observations that while the highlights of Civil War experience in recruitment which we usually recall are the draft riots which almost tore the North apart, almost the only successful recruitment during the Civil War, and the great bulk of it, was done by obtaining volunteers. The chapters by Tollison remind us of some of the hypocrisy of concern with racial balance in a volunteer army when many of those who would be freely volunteering at higher pay are now forced into that same army under conditions of some of the worst exploitation, in the literal sense of that term, to be found in our society. He also offers telling arguments against the concern that a professional army of "mercenaries" might be more destructive of democratic governments. The historical fact, we are reminded, is that from Napoleon's day on, armies of conscripted enlisted men, led by professional or "mercenary" officers have destroyed democratic regimes. Greece and Argentina, it is suggested, are two relevant recent examples. The danger of military coups and revolts seems to stem from the officer classes, and they are essentially "volunteers" in any event.

The case for the volunteer army does seem overwhelming. In an early chapter, Johnson "demolishes" the various alternatives: selective service, national service, and a lottery system. And Miller, in conclusion, points out some of the techniques for accomplishing the transition: "immediate raise in pay for first-term enlisted recruits," "improved working conditions for military personnel," "more energetic and creative recruiting policies," "economy in the use of military personnel," "a date set for the termination of conscription with its possible future use tied to an act of Congress," and "a well-trained volunteer reserve."

This reviewer is convinced that a volunteer system is a most efficient, equitable, and generally desirable method of recruiting armed forces. He has been so convinced for some time and would indeed argue against a draft

even in the unlikely case of need again for mass armies as in World War II. On this latter point, paradoxically, Blum's presumably sympathetic account of World War II Selective Service experience leaves me more convinced than ever of the need to do away with the draft.

A few difficulties, however, may be worthy of further attention. For one thing, it will have to be recognized that the added budgetary cost of a volunteer army could indeed be considerably greater than the implicit tax now paid by draftees, if the Armed Forces prove unable to establish sufficiently differentiated pay scales. For in that case huge numbers of volunteers would receive a "rent" which would make their own pay far more than that necessary to induce *them* to volunteer.

But second and potentially more serious is the paradoxical possibility that the lesser real cost of a volunteer army will make it more dangerous. One may well have a concern that one's government will be more inclined to get involved in foreign adventures—as the world's policemen, in common parlance—if it is not inhibited by the immediate cost of an inefficient army of conscripts. This cost in a democracy may be not only economically but politically high as witness, perhaps, the launching of political crusades against the Johnson Administration just when college students, in 1968, began to face the imminence of conscription for an unpopular war at the end of their undergraduate studies. But with a volunteer system, may it not be possible, particularly in a country as large and wealthy as ours, where the needs for Armed Forces are relatively small, to find a small minority of the population with the taste for adventure, combat, and perhaps brutality, who could prove a ready instrument of a dangerous and adventuresome foreign policy. In the best of nations, after all, there may be many sadists of storm trooper mentality. Would a system of self-selection at not necessarily much greater pay than we have now result in such an army? Adventuresome leaders could use such an army as they wished with relatively little economic cost—such volunteers would not require great pay—and with the main body politic relatively unconcerned.

Yet such a situation might be repugnant not only to the principles of humanity and international brotherhood with which many of us are concerned. It might also tilt the political scales in the direction of a policy which ultimately could lead our own nation to disaster. Our world policemen would earn the enmity which so many in the world feel for policemen. And in a world in which Americans, rich and powerful as they are, remain a small minority, in this enmity may grow the seeds of disaster.

I am concerned with this danger but would look to an enlightened citizenry in a democratic society to destroy it. In the words of the editor of *Why the Draft?*, "The Case for a Volunteer Army seems so overwhelming. It is time that we returned to our heritage of equity and individual freedom and instituted voluntarism in our military manpower procurement."

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*Principles of Economics.* By ROYALL BRANDIS. Homewood: Richard D. Irwin, 1968. Pp. xix, 693. \$8.75.

*Scarcity Challenged: An Introduction to Economics.* By HEINZ KOHLER. New York: Holt, Rinehart and Winston, 1968. Pp. xxviii, 660. \$9.95.

Brandis' *Principles of Economics* is intended as a basic textbook for a comprehensive one-year introductory course. Although it is built on material from an earlier one-semester principles text, the revision is so thoroughgoing and so much new material has been added that the book is brought out as a new book, not a revision of the older book.

The book is written and designed to challenge and stimulate the beginning economics student. It is very lucid and readable, and there are no footnotes or reading lists. There is a *Student Study Guide* and an *Instructor's Manual*. In each subject matter area there is first a discussion of theory and then of policy and other current economic problems and issues.

Some of the features of the book include a discussion of the development of the American economy, an analysis of regional economics including location of industry, a thorough discussion of manpower and population problems, a more rigorous theory of growth, and an excellent integration of monetary and national income theory. The socioeconomic problems of urbanization and migration of population are well covered. Another interesting feature is the coverage of both the micro and macro problems and implications not only of unemployment but also of taxation and government expenditures as well.

The text is divided into six parts. Part I, the Introduction, is excellent. It includes a discussion of understanding economics and economists and an introduction to economic analysis. Skillful use of the production possibility curve is made. Two chapters are devoted to the past and recent economic development of the United States. Part II deals with Macroeconomic Analysis and Policy, but the book is written in such a way that microeconomics could easily precede the macroeconomics section.

Part II covers price level changes; money, banking, and monetary policy and control techniques; national income accounts; national income theory along with a detailed discussion of the consumption function, the accelerator, and the role of interest rates; an excellent and somewhat novel (for introductory texts) integration of monetary and real economic analysis—both the LM and the IS curves are discussed at length; a macroeconomic analysis of taxation and public expenditures; and finally fiscal policy and national debt considerations.

Part III covers Problems of Growth and Change. Several simple growth models are presented, including a discussion of the "ideal" capital stock, population and economic growth, and equilibrium and disequilibrium growth rates. In a chapter on Economic Growth and Development, an interesting diagram (p. 272) relates savings and investment to capital stock and increased productive capacity. The cultural, economic, and political aspects of economic development of underdeveloped countries are thoroughly explored. For developed nations, there is a detailed analysis of the determinants of savings and

investment. The section concludes with an analysis of population problems and theories including biological, economic, and sociological, and the "Great Dilemma."

Part IV deals with Microeconomic Analysis and Policy. An overview chapter discusses the determination of relative prices via supply and demand including the "Cobweb Theorem." Next is the analysis of both the utility and indifference curve approach to demand analysis. Even advertising is brought into the picture. Both the income and the price or substitution effects of a price reduction are explored, something rather unusual for introductory texts. Similarly there is a detailed discussion of cost and supply curves and how supply and demand interact for the competitive firm both in the short and the long run. Next follows a penetrating chapter on Agricultural Policy with an exposure of the "nonsense about agricultural policy" as well as a discussion of some of the more logical reasons for farm programs. The presentation then switches to the Monopolistic Firm and the problem of the public utility firm. Following a chapter on imperfect competition covering both monopolistic competition and oligopoly including price leadership, the kinked demand curve, and the "nonsense about advertising," there is a chapter on business organization and government regulation. Then there are two chapters on the Rewards to the Productive Factors covering wages, rent, interest, and profit. Chapter 29 presents a novel microeconomic view of taxation and public expenditure. Chapter 30 on Regional Economics explores regional per capita income differentials, mobility of resources, and populations shifts as well as location of industry with different models. The highlight of this section, however, to this reviewer is the concluding chapter on The Classical Model of the Economic System which is excellent.

Part V consists of two chapters on International Economics covering foreign trade, finance, and economic policy. Part VI concludes with a chapter on Marxism and the Soviet Economy, and another on Government and Our Economic Life. The latter discusses the economic, ethical, and political limitations on government relative to our economic aspirations, goals, and problems.

The Kohler book, *Scarcity Challenged*, a new text, was written because the author realized that many students find economics dull and boring and distastefully complicated and involved. The hope was to make economics both interesting and enjoyable to the student. The result was a unique approach to introductory economics built around the central economic problem of scarcity. The organization of the book revolves around the goal of reducing scarcity to a minimum and a discussion of the methods of achieving this goal. Topics are not discussed in the traditional sequence or under the standard headings found in traditional textbooks, but rather in response to the questions of full use of resources, efficient use of resources, growth, and finally the ethical conflicts between economic and noneconomic goals. For example, there is no International Economics, yet the relevant material is discussed throughout various appropriate parts of the book. Also there is no discussion of the marginal productivity theory of distribution. Nevertheless, most of the conventional topics are discussed in one place or another.

One very interesting feature of the text is the way the author incorporates the study of a Socialist state into all phases of economics just as he does that of a Capitalist state, rather than having a brief isolated section on Comparative Economic Systems. Thus there are six chapters on Socialism and the USSR instead of the conventional one or two.

The text comes in a complete package with a *Study Guide*, *Book of Readings*, and an *Instructor's Manual*. Each chapter has a summary, glossary of terms, and list of questions. Only a very limited list of basic references is provided and that at the beginning of the book. The text is designed to improve the overall teaching and effectiveness of elementary economics.

The book is divided into four parts. Part I deals with Full Employment of Resources. This section is written from a macroeconomic point of view. Some ten chapters deal with a developed Capitalist economy, the United States, and three chapters with a developed Socialist economy, Russia. Chapter 2 covers the meaning and extent of unemployment and chapters 3 and 4, National Income Accounting. Chapter 5 covers both the Classical and the Keynesian theories of income and output determination. Chapter 6 deals with business cycles and forecasting with the help of an accelerator-multiplier model. In an attempt to integrate statics and dynamics, use is made of period analysis. Another four chapters cover money and banking, monetary policy, government spending and taxing, and fiscal policy. Chapter 11 is a very interesting and unique chapter on the major obstacles to the achievement of full employment without inflation. Topics such as wage-price guidelines and federal programs to increase labor skills and mobility are discussed.

Part I concludes with three chapters on the Nature of Central planning, central planning in Russia, and a discussion of current Soviet levels of employment, output, and prices. Input-output analysis is introduced as well as an understanding of the work of "the price system" whether it be in a Capitalist or a Socialist state. The interdependence of the entire economy is discussed as well as the difficulties of dealing with it centrally.

Part II deals with the Efficient Employment of Resources. Chapter 15, an excellent chapter, analyzes the meaning of economic efficiency including the Paretian Optimum. It covers the production possibility curve, consumer indifference curves, marginal rates of substitution and transformation, and the optimum composition of output.

Four chapters deal with efficiency in Capitalism. Chapter 16 covers the dream world of perfect competition. Here the conventional topics of demand, revenue, productivity, cost, and supply are discussed. Both the goods and the resource markets are analyzed as well as both partial and general equilibrium. Then economic efficiency is examined under perfect competition. Here self-interest can be relied upon except where externalities enter the picture. Chapter 18 examines the real world of imperfect competition in both the goods and resources markets. It is explained that equilibrium and efficiency may diverge just as equilibrium and full employment. The last chapter deals with economic inefficiency and the role of the government. No master plan is presented, just a theory of the "second best." The role of the government as both the guardian and the destroyer of competition is analyzed.

Then efficiency under Socialism is considered. In Chapter 20, Socialism: The Competitive Solution, Lange's model of competitive socialism is developed along with some uses of linear programming. The next chapter relates the Lange model to present decentralization reforms in Russia today. Liberman's proposals are discussed, and the results to date of partial adoption by Russia.

Part III examines Growth. Three chapters cover, respectively, growth in the United States, Russia, and underdeveloped countries. An interesting brief case study of development in China and India is included. The meaning, significance, and ingredients of growth are analyzed as well as the case for governmental policy in a Capitalist economy. Similarly, the Russia strategy for development is discussed and its record to date.

Part IV, Beyond Economics, concerns itself with economic justice, poverty, distribution of income, and antipoverty programs. The last chapter, 26, examines the problems of freedom versus economic welfare, and the dangers of power.

Both books are not without their limitations and shortcomings. Nevertheless, both will make excellent introductory texts, and each should win easily its share of followers and adopters. Clearly in the case of the Kohler book, more experimentation and innovation in basic economic texts should be encouraged if economics is not to be the "Dismal Science" for so many beginning students.

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### **Price and Allocation Theory; Related Empirical Studies**

*Auctions and Auctioneering.* By RALPH CASSADY, Jr. Berkeley and Los Angeles: University of California Press, 1967. Pp. viii, 327. \$7.50.

I think the general welfare in professional economics might be significantly advanced if economic theorists, particularly price theorists, would devote ten per cent less time to studying each other's papers and allocate the time to studying works like this one on the institutional aspects of auction market history, procedures, and processes. Price theorists, with a concern for what Bertrand Russell has called analytical empiricism, can find in this book and similar works on the stock and commodity markets the grist for many years of research, grinding out models of price making and adjustment processes conforming to the great variety of different auction systems that have evolved from the trading ingenuity of man.

Auctions are a particularly important form of price adjustment mechanism where the commodity is not homogeneous, and compensation must be adjusted for quality differences among different items or different lots of the same good. Thus, one of the earliest auctions existed in Babylon around 500 B.C. where women of marriageable age were sold annually to buyers on condition that they be wed. Competitive bidding established premium prices for the more attractive maidens and lower prices for the less attractive ones. Many of the least attractive were unable to command

a positive price, and the bidding centered on the size of the dowry to be offered with the girl to induce someone to accept her in marriage.

He who might consider this to be a barbaric institution is reminded that in the American Old South auctioning of slaves showed no improvement over the Babylonian marriage auctions in either method or attitude on the part of vendors toward their human property. Healthy young men commanded premium prices, and women were in brisk demand—some for child production, some as servants, and some as “fancy” women. Children were acquired as speculations on future productivity, but also to keep families together—perhaps out of a sense of “Christian duty,” but more likely out of a practical regard for minimizing dissension. At auction the “merchandise” was displayed as in ancient Babylon, while the less desirable slaves were disposed of by inclusion in family groups containing at least one valued slave. Differences in value were often obscured by the practice of basing the bid on an average price per person in the group. Thus did the tie-in sale substitute for the dowry sale of Babylon.

One final item in the colorful history of the auction: the Romans regularly employed the auction in commercial trade and property liquidations. But the most famous Roman auction was in 193 A.D. when the Praetorian guard killed the Emperor Pertinax and offered the crown, and with it the entire empire, to the highest bidder. The winning bid was 6,250 drachmas for each guardsman.

The two auction systems most familiar among western nations are known as the English auction and the Dutch auction. The English is an ascending-bid auction in which the auctioneer either solicits an opening bid or suggests a bid. Thereafter, successively higher bids are recognized until a highest bid prevails, and the item is “knocked down” to this remaining high bidder if it is not below the seller’s limit or reservation price. I will provide a formal but very simple treatment of the English auction mechanism, and then interpret Cassady’s discussion of some of the institutional aspects of the system in terms of this model.

Consider  $m$  buyers, the  $i$ th buyer having a fixed maximum bid price  $P_i$  based on his subjective evaluation, and let the buyers be numbered so that  $P_m > P_{m-1} > \dots > P_1$  in a postulated strictly descending array. Tied maximum bid prices are no problem as such bidders are interchangeable. A single item or indivisible lot of goods is offered at a starting bid  $\underline{P} < P_{m-1}$ . Assume  $p \leq P_m - P_{m-1}$ , where  $p$  is the fixed bid increment, i.e., the increment by which a new bid must exceed the preceding bid, as required by the rules, say, of the auction. If  $n_s$  is the integral number of bids beyond the starting bid required to produce equilibrium, then the equilibrium price  $P_s^0$  must satisfy the inequality  $P_m \geq P_s^0 = \underline{P} + n_s p > P_{m-1}$ . We have strict inequality on the right since a bid of  $P_{m-1}$  will be overbid by buyer  $m$ , and on the left no buyer will bid in excess of  $P_m$  by hypothesis. The convergence time to equilibrium, as measured by the integral number of rejected bids  $n_s$ , must satisfy  $(P_m - \underline{P})/p \geq n_s > (P_{m-1} - \underline{P})/p$ . Define  $x = (P_{m-1} - \underline{P})/p$  as the “distance,” measured in (fractional) bid increment units, from starting price  $\underline{P}$  to the second highest limit bid,  $P_{m-1}$ , and  $I[x] = \{\text{smallest integer}$

$> x\}$ . Then  $P_e^0 = \underline{P} + pI[(P_{m-1} - \underline{P})/p]$  is the explicit equilibrium price in terms of the given data.

Now consider some of the significant ways in which the English auction has varied in different institutional settings. When applied to relatively standardized commodities, auctioned on a regular schedule, where the buyers are likely to exhibit similar subjective valuations, such as tobacco and livestock, the bid increments are fixed as in the above model (p. 59). Sometimes, as in the auctioning of books in eighteenth-century England, the rule covering bid increments defines a two-step minimum increment, to wit, "that no person advances less than sixpence each bidding, and after the book arises to one pound, no less than one shilling" (p. 269). Again, in slave auctions, when the price approached equilibrium, "it was the practice of the auctioneer to narrow the amount of the advance from, say 50 dollars to 25 to 10 or even 5 dollars" (p. 36). Still more flexibly, in London antique auctions, where the spread in subjective valuations can be very wide, the auctioneer "calls actual bids only, and, when a bidder offers to advance, determines the amount of the increment and enunciates the bid" (p. 59). All such rules and practices governing  $p$  (and also the starting price  $\underline{P}$ ) can be interpreted in terms of their economic effect on transaction cost and the equilibrium price. In the above model in order to insure  $P_e^0 > P_{m-1}$ , it was assumed that  $p \leq P_m - P_{m-1}$ . Otherwise, a bid at somewhat below  $P_{m-1}$  could stand without an overbid, and the seller would have extracted an inefficient price in that further gains from trade would be possible. Thus, the larger is  $p$  for a particular auction the greater is the expected opportunity cost due to a lowered selling price. On the other hand, the larger is  $p$  the lower is expected transaction cost due to more rapid convergence. A rough balancing of these costs represents a mechanism which may help to understand the variation in rules and practices among different institutional applications of the English auction. The device of lowering  $p$ , as in the old slave auctions, provides a means of focusing most of the transaction time (cost) on the fine selection of the equilibrium price. In the antique auctions where values may be disparate, and high relative to transaction cost,  $p$  floats at the discretion of the bidders from one bid to the next.

The English auction stands in sharp contrast to the Dutch auction in that the latter is a descending-bid auction in which the auctioneer opens with a high price and successively lowers the quotation until a buyer accepts the bid, and we have equilibrium. In the spirit of the previous model, suppose we have the same array of limit prices  $P_i$ , with an opening bid  $\bar{P} > P_m$ . Define, as before, the bid increment  $p \leq P_m - P_{m-1}$ , and let  $n_d$  be the integral number of bids to equilibrium in the Dutch auction. Then if  $P_d^0$  is the equilibrium price, we must have  $P_m \geq P_d^0 = \bar{P} - n_d p > P_{m-1}$ . The convergence time in terms of number of bids to equilibrium,  $n_d$ , must satisfy  $(\bar{P} - P_{m-1})/p > n_d \geq (\bar{P} - P_m)/p$ . Now define  $y = (\bar{P} - P_m)/p$  as the starting distance to  $P_m$ , in bid increment units, and  $J[y] = \{\text{smallest integer } \geq y\}$ . Then in explicit form the equilibrium price is given by  $P_d^0 = \bar{P} - pJ[(\bar{P} - P_m)/p]$ .

An example may help to contrast the two auctions. Let the limit bid

array be  $P_m = 5.50 > 5.10 > 5.00 > 3.00 > 2.00 > 0.50 = P_1$ , and  $\bar{P} = 10.00$ ,  $\underline{P} = 2.00$ , with  $p = 0.30$ . Then from the above formulas  $P_d^0 = 5.30$ ,  $P_d^0 = 5.50$ .

Abstracting from the influence of the bidding process and the auctioneer on the buyer limit prices it is clear that, if  $p$  is very small,  $P_d^0$  will be near  $P_{m-1}$ , while  $P_d^0$  will be near  $P_m$ . This is readily proved from the above formulas by letting  $i = I(x) - x$ ,  $1 \geq i > 0$ , and  $j = J(y) - y$ ,  $1 > j \geq 0$ . Then  $P_d^0 = P_{m-1} + pi$ ,  $P_d^0 = P_m - pj$ , and  $\lim_{p \rightarrow 0} P_d^0 = P_{m-1}$ ,  $\lim_{p \rightarrow 0} P_d^0 = P_m$ . For arbitrary  $p \leq P_m - P_{m-1}$  it is not even the case that  $P_d^0 > P_d^0$  as is easily demonstrated with examples. However, for  $p \leq \frac{1}{2}(P_m - P_{m-1})$  it is correct to say that the Dutch auction equilibrium is above that of the English auction, since then we can write  $P_d^0 - P_d^0 = (P_m - P_{m-1}) - p(i+j) > (P_m - P_{m-1}) - 2p \geq 0$ . These results, even though based on extremely simple models, will perhaps help to illustrate the value of formalizing the mechanisms of market institutions. In particular, they show the crucial importance of the bid increment in judging the price advantage of the Dutch auction over the English. Important interesting extensions of these models would account for each bidder's uncertainty concerning the maximum limit bid in the group, the effect of bid information on this uncertainty, and so on.

Many other auction systems prevail. The Japanese auction uses simultaneous bids, in that all bidders display their bids by hand signs at approximately the same time. This is a very high speed auction in which the auctioneer acquires great skill in quickly selecting the high bid from a sea of hand signals. Interestingly enough the high speed Japanese auction finds its important applications in the Tokyo fresh fish market and the Osaka fruit and vegetable markets (where electronic devices are now used) in which perishability implies high transaction cost. Less perishable products, such as dried fish in Japan are sold at written-bid auctions. The written-bid auction is similar in structure to the Japanese simultaneous-bid auction in that the winning bid is determined by scanning all bids at the same time. However, in the Japanese auction using hand signals the few moments required by the auctioneer to determine the high bid can be used by the buyers to alter bids. In the same functional category as the Japanese and written-bid auctions one should include the Karachi-Pakistan handshake auction (the bid is communicated to the auctioneer by the squeezing of fingers) and the whispered-bid auctions (e.g., Singapore, Manila). All these auction schemes are characterized by relatively close or even complete control on bid information. To the extent that there are externalities involved in the subjective valuations put on a commodity, this scheme permits the bid limits to be determined independently by each bidder with a control on inter-bidder influence. Such a scheme could be important as an institutional means of promoting trade while minimizing interpersonal conflict in the social group. It favors the buyer insofar as it prevents the oral process from stampeding some bidders into higher bids than they would care to have made in a more reflective mood. In comparison with the English auction, these auctions favor the seller insofar as the limit bids are not interpersonally determined, and there is a wide spread between the first and second highest limit bids.

Space prevents discussion of the strategy and tactics of selling and pur-

chasing, and the fascinating machinations of "buyer rings," all of which is very rich ground to challenge the skill of the game theorist. Even the cybernetic age has had its impact on auctioning, with the electronic clock to facilitate operation of the Dutch auction, an electronic keyboard system for the Japanese auction, and the use of television to permit distant or overflow buyers to participate in auctions.

Cassady has performed a splendid service in providing economists with a scholarly and comprehensive treatment of auction practices. This book together with the various institutional books and brochures on the "double auction" organized exchanges (and over-the-counter markets) in securities and commodities, provide a wealth of observations on the sophisticated price adjustment mechanisms operating in those markets most closely approximating the competitive markets of economic theory.

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*Introduction to General Equilibrium Theory and Welfare Economics.* By JAMES QUIRK AND RUBIN SAPOSNIK. New York: McGraw-Hill, 1968. Pp. 221. \$8.95.

Bringing topics from modern economic theory within the reach of students always presents problems. Providing both a reasonable amount of formal argument and intuitive explanations that convince students of the relevance of a theory is not an easy task. Quirk and Saposnik have succeeded in overcoming these difficulties in a very satisfying fashion. Given the goal of the book, it is difficult to criticize it in any major way, but one might, as will be pointed out, raise a question as to where the book fits into the usual economics curriculum. Before specifying this question the contents of the book will be outlined.

The book begins with an elementary discussion of the background of economic theory and of vectors and vector operations. It moves on through a discussion of the theory of consumer's preferences and demand to a treatment of elementary production theory. After this introduction the authors take up sets and operations with sets. This is followed by a brief discussion of functions, correspondences and maximization, which serves as a basis for developing the characteristics of supply and demand functions.

A segment of the book is devoted to the existence of competitive equilibrium. This portion begins with a description of the problem of competitive equilibrium in the case of a single good. From this beginning the more general problem of competition equilibrium is explored with the arguments relying on fixed-point theorems. A good review of the recent developments in the area is included.

The treatment of welfare economics begins with a consideration of the social welfare function and the Arrow impossibility theorem. The Pareto-optimum, treated as a unanimity rule, is explored in a rather extensive fashion. There is also a lengthy discussion of the compatibility of the Pareto-optimum and competitive equilibrium which is based largely on Arrow's paper in the *Second Berkeley Symposium*.

Returning to competitive equilibrium, the authors deal with both static and



dynamic aspects of the stability of competitive equilibrium. The static case is handled in Hicksian terms, while in the dynamic case reliance is placed on the *tâtonnement* mechanism. Both local and global stability are discussed. The final segment of the book is devoted to comparative statics and qualitative economics. A part of this last segment has been condensed quite drastically and may prove a bit difficult for students as a consequence.

The organization of the book and its separate segments is very good. Topics are introduced in logical sequence and the relationships between the various subjects are pointed out specifically, showing an awareness of student needs. This regard for the student carries over into the mathematical presentation. The authors do not strive for full mathematical rigor. Although many of the propositions presented are proved rigorously, the mathematical tone of the book is heuristic, and appeals are made to the reader's economic intuition. It should be mentioned that the quality of the exposition is good throughout. In short the book seems to be designed and executed with the student in mind.

The book assumes a previous knowledge of both elementary economics and elementary mathematics on the part of the reader, but the levels assumed are not great. Indeed some of the topics, such as demand and production theory, are developed from elementary beginnings. But even in these cases the treatment of very elementary considerations is quite spare; one would expect beginners to need a more discursive discussion of economic elements than is provided. On the mathematical side a knowledge of differential calculus is assumed. Other mathematical topics are given at least a cursory explanation before they are used. As a consequence it seems reasonable to conclude that the book is suitable for advanced undergraduates, although it might also be used profitably by beginning graduate students.

A final point relates to the place of the book in the economic curriculum. Probably few departments offer or intend to offer an undergraduate course in general equilibrium theory and welfare economics. Certainly the book is not intended for one of the traditional undergraduate courses. And instructors in more specialized graduate courses may prefer to go back to the original sources. Thus the book's position as a textbook is a bit ambiguous. Since it appears as an item in the publisher's "Economic Handbook Series," it is likely that it is intended as a reference work rather than as a textbook. But regardless of where it fits into the curriculum it is an excellent piece of expository writing.

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*An Introduction to Modern Demand Theory.* By SHIH-YEN WU AND JACK A. PONTNEY. New York: Random House, 1967. Pp. ix, 270. \$8.95.

According to its authors, Shin-Yen Wu and Jack Pontney, the purpose of this book is to "bridge the gap between the literary and mathematical approaches to consumer demand theory" and "more importantly . . . to present an introduction to modern demand theory." Most of the book treats demand theory under "static certainty" and the core of *Modern Demand Theory*

(consisting of three chapters comprising almost half the book) is devoted to the utility, preference, and revealed preference approaches to demand theory. The discussion of demand theory under static certainty also includes chapters on "Marshallian Demand Theory," "Boundary Conditions," and the "Elasticity of Demand." "Static Uncertainty" and "Dynamic Certainty" are each allotted a chapter.

One can, of course, argue with the choice of topics. I would gladly trade the discussion of Marshallian demand theory or elasticity for an analysis of separable utility functions, the theory of cost of living indices, the problems of aggregation, (either over goods or individuals) or the relationship of theoretical to empirical demand analysis. But this is obviously a matter of personal preference.

In view of their stated objective of "bridging the gap," Wu and Pontney do a surprisingly poor job of explaining their results in nonmathematical terms. While the literary economist cannot follow difficult mathematical proofs, he can understand both the hypotheses and conclusions of many of the important theorems of mathematical economics. He can certainly understand the axioms of consumer preference under "static certainty," but Wu and Pontney's exposition of these axioms is quite weak. A far better discussion can be found in Chapter 2 of Peter Newman's excellent book, *The Theory of Exchange*. Similarly, Wu and Pontney give almost no explanation of the von Neumann-Morgenstern axioms of consumer preferences under "static uncertainty," and the student who is not already familiar with these axioms would do better to consult Chapter 2 of Luce and Raiffa's *Games and Decisions*.

The same reluctance to motivate and explain concepts in economic terms is manifest in the two chapters on "Marshallian Demand Theory." Wu and Pontney are concerned with definitions and technical manipulations, but they make virtually no attempt to explain why economists might be interested in either what they present as the original Marshallian case or the more sophisticated interpretations of Hicks or Friedman.

Probably because they are attempting to bridge the gap, the mathematical level of the discussion varies widely within individual chapters. It is difficult to set standards by which to judge the book's rigor because it is unclear what level of rigor is being aimed for. A few examples will illustrate the difficulties. (1) In order "to keep the mathematics at a reasonable level" the authors consider the revealed preference approach only in the context of a two-good world. But in the two-good case, as they point out, the weak axiom of revealed preference implies the strong axiom, so the cost of "keeping the mathematics at a reasonable level" is quite high. (2) Although Wu and Pontney assume that choice functions are continuous with respect to income, they do not explicitly assume that they are differentiable with respect to prices or income. Nevertheless, they make free use of these partial derivatives (pp. 112, 118). (3) In discussing the utility approach to demand theory, Wu and Pontney assume that the utility function is defined on the region where the quantities of the two goods are positive. This assumption is made to enable them to deal separately with situations in which all goods are consumed in positive quantities and those in which some goods are not consumed at all.

Although this assumption does preclude boundary solutions, it does so at the cost of introducing a more serious problem. If maximization of a well-behaved utility function defined for all nonnegative quantities subject to a budget constraint leads to a boundary solution, and if the domain of the utility function is restricted to the strictly positive region of the commodity space, then the restricted utility function will not attain a constrained maximum. In general, the intersection of the feasible set (defined by the budget constraint) and the domain of definition of a utility function defined only for positive quantities is not compact; hence, the existence of demand functions is not guaranteed. For a set of assumptions which guarantee that utility maximization subject to a budget constraint will lead to an interior maximum see Samuelson's "Using Full Duality . . ." (*Econometrica*, October 1965, p. 782).

The book includes a mathematical appendix which summarizes the relevant definitions and theorems from calculus and matrix algebra. It lacks exercises (which are such an important and useful feature of Wold and Jureen's *Demand Analysis*) and a critical bibliography to guide the student through the literature.

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### Income Theory; Related Empirical Studies

*Determinants of Investment Behavior*. Edited by ROBERT FERBER. National Bureau of Economic Research, Universities-National Bureau Conference Series, No. 18. New York: Columbia University Press, 1967. Pp. xi, 611. \$15.00.

The University of Wisconsin provided the setting in June 1965 for a two-day conference on investment sponsored by the Universities-National Bureau Committee for Economic Research. The conference was intended to "bring together the work of people studying the investment decisions of different economic units and to compare the methods employed and the nature of the results obtained," as Robert Ferber states in his introduction to this volume of proceedings. Papers on government investment were originally to be included, but "because of the sparse analytical work on the subject," these plans were dropped. The organizers of the conference apparently overlooked the vast amount of work being done on cost-benefit evaluations of public projects and on the impact of financial market conditions on investment expenditures of state and local governments. The basic inputs to the conference were 12 papers, grouped under five headings, which were scrutinized by some 14 discussants.

Part I, "Anatomy of Investment Behavior," consists of papers by Jean Crockett and Irwin Friend and by Dale W. Jorgenson, with comments by James Tobin, Zvi Griliches, and Roger F. Miller.

The Crockett-Friend paper, "Consumer Investment Behavior," is a long, tedious chronicle of efforts to estimate income elasticities of net worth and saving and their components using cross section and panel data for 1960-62.

Both normal and transitory income elasticities are investigated, and attempts are made to adjust for differences in tastes among households. Desired asset levels are assumed to be a function of normal income; and saving is viewed as a stock adjustment process, with allowance for the possibility of a buffer stock role for some assets. The most noteworthy finding is that the long-run normal income elasticity of total net worth and the short-run normal income elasticity of total saving are considerably greater than one, which does not square with the common version of the permanent income hypothesis. The authors also find very low adjustment speeds for many assets.

A few background remarks are needed to place Jorgenson's paper in perspective. Net investment is commonly viewed as a disequilibrium phenomenon representing firms' efforts to adjust their actual stocks of capital to desired levels. Suppose that a firm is in equilibrium (actual and desired stocks are equal). A fall in the interest rate, *ceteris paribus*, will increase the desired stock; and in the absence of adjustment costs, the firm's investment demand will be infinite. To obtain a determinate investment function, theorists have had to introduce adjustment costs or capacity limitations in the sector supplying capital goods. But in "The Theory of Investment Behavior," Jorgenson shows that, under certain conditions, an investment demand function can be obtained from a comparative dynamics analysis based on the neo-classical theory of capital accumulation. If the time paths of all exogenous variables are smooth and continuous, the firm can be assumed always to be in equilibrium, i.e., its desired and actual stocks are equal at each point in time. If there is a change in the time path of, say, the interest rate beginning at time  $t_0$ , present and future prices of capital goods must change so as to keep the *present* implicit rental price of capital goods and the associated desired capital stock constant, for otherwise the firm would not be in equilibrium at  $t_0$ . But *future* values of the implicit rental will change, thus changing the path of the desired capital stock and investment. Jorgenson shows that the relationship obtained between investment demand and the rate of interest is indeed a finite and negative one. By shifting the analysis from the conventional comparative statics approach, in which one is faced with explaining the disequilibrium path between two equilibrium points, to a comparative dynamics approach, in which one attempts to determine the change in the equilibrium path given a change in the underlying data, Jorgenson has established a very interesting new theorem. His paper certainly repays careful study both for its content and its analytical technique.

Part II, "Financial Aspects," contains papers by Merton H. Miller and Franco Modigliani and by John Lintner, with comments by J. Fred Weston and Irwin Friend.

The Miller-Modigliani paper, "Estimates of the Cost of Capital Relevant for Investment Decisions Under Uncertainty," has already appeared in a lengthier and slightly revised form in the June 1966 *American Economic Review* and is probably familiar to most students of investment analysis and finance. The firm's cost of funds is a weighted average of the cost of debt and the cost of equity, the weights being determined by the desired debt-equity ratio. The cost of equity is the market's capitalization rate for unlevered

equity earnings streams of firms in a given risk class, and the cost of debt is one minus the tax rate times the cost of equity. Miller and Modigliani have estimated the capitalization rate and the implied cost of funds for electric utilities in 1954, 1956, and 1957—quite a chore, because one has to take account of the influence of expected growth in earnings. Comparing their estimates of the cost of funds with two commonly used measures of the cost of funds, the bond yield and a weighted average of equity and bond yields, they find that the usual measures understate the rise in the cost of funds over this period, but that the bond yield is the better predictor of the level and rate of change of the cost of funds.

In "Corporation Finance: Risk and Investment," Lintner maintains that the negative relation between the cost of funds and leverage found in the Miller-Modigliani approach conflicts with the opinions of financial officers and with some empirical findings and results from the assumption that bonds are viewed as riskless assets by their owners. If both bonds and stocks are risky assets, the cost of funds should be an increasing function of leverage. Lintner proceeds to test the alternative hypotheses by determining empirically the relation of investment expenditures to acceleration, interest rate, and leverage variables in quarterly data for manufacturing for 1953-63. Investment is found to be significantly and negatively related to leverage, which lends support to the view that the cost of funds is positively related to leverage.

Part III, "Consumer Assets," contains papers by Richard F. Muth, Gordon R. Sparks, Marvin Snowbarger and Daniel B. Suits, and Roger F. Miller and Harold W. Watts, with comments by Louis Winnick, Vernon G. Lippitt, and James Morgan. With the exception of Sparks' fine paper on residential structures and Lippitt's excellent comments on three of the studies, this section is disappointing.

Muth's "The Distribution of Population within Urban Areas," bears only indirectly on the topic at hand, or for that matter on the topic of the volume. Building on his earlier work, Muth uses 1950 cross section data on 36 cities to study the determinants of urban decentralization. The major finding is that urban decentralization is greater where costs of auto transport are lower (car registrations per capita are used as a proxy for this variable—a not altogether satisfactory procedure) and where the urban population is larger. The racial composition of the central city plays a marginally important role. Only limited confirmation is found for the "flight from blight" hypothesis—the proportion of central city dwelling units that are substandard is not an important determinant of any of the variables studied. Population densities and changes therein undoubtedly have some impact on the level and spatial distribution of investment expenditures in urban areas, but the author offers only a few brief speculations on these possible interrelations. As Winnick notes in his comments, the link between population movements and investment in residential structures may be a very loose one. Such investment is probably closely related to changes in the number of households, and while many large cities lost population between 1950 and 1960, they gained households.

In "An Econometric Analysis of the Role of Financial Intermediaries in Postwar Residential Building Cycles," Sparks attempts to explain annual

housing starts over the 1949-64 period using a model that draws on Sherman Maisel's important contributions to this area and includes a detailed treatment of the supply of mortgage funds. Sparks specifies housing starts to be a function of net household formations, the inventory of houses under construction plus vacancies, mortgage credit terms, the ratio of a rent index to a construction cost index, and disposable income. Mortgage terms are determined by demand and supply conditions in the mortgage market, with demand assumed to be a function of the same variables as housing starts and with supply equal to the sum of the funds (actually loans dispersed without prior commitment plus forward commitments) supplied by savings and loan associations, mutual savings banks, life insurance companies, and commercial banks. The quantity of funds supplied by each institution depends on its total savings deposits, repayments on outstanding mortgages, the ratio of mortgages held to deposits, mortgage credit terms, and an interest rate measuring the yield on alternative investments. The model explains this period quite well, although it seems to be going off course after 1960. As to the roles of final demand and the supply of funds in the countercyclical behavior of housing starts, Sparks finds that declines in final demand in the 1954 and 1958 recessions were offset by sharp declines in interest rates, so that the supply of funds effect was the dominant force. However, in the 1955 and 1959 recoveries the growth of final demand more than offset the rise in the interest rates, and in the 1960 downturn the decline in interest rates was not great enough to offset the sharp fall in demand. Thus, it appears that both demand and financial conditions are important determinants of the countercyclical pattern of housing starts, contrary to the common view that the behavior of housing starts results solely from the countercyclical flow of funds in and out of the mortgage market. This is indeed a fascinating paper—carefully developed and clearly presented.

In "Consumer Expenditures for Durable Goods," Snowbarger and Suits examine data from the 1957 and 1960-63 Surveys of Consumer Finances to determine the characteristics of households that purchase or hold certain consumer durables. They use a statistical procedure that is especially designed to detect interactions of variables and is superior to regression analysis in this respect. Their procedure is to carry out successive partitions of the households, the partitioning characteristic at each stage being the one most highly correlated with the preceding characteristic. The end result is a "tree" of two-way splits which the researcher can study to discover significant interrelationships. For example, their analysis reveals that disposable income is the most important determinant of multiple-car ownership in 1962-63, that among low-income families the most influential factor is the work-status of the wife, that among low-income families with wives earning less than 68 per cent of the income the most important influence is age of children, that among high-income families the most important influence is age of children, that among middle-income families the most important influence is place of residence (urban or rural), etc. Consumer purchases of television sets, refrigerators, washers, furniture, and autos are found to be closely associated with intentions to purchase, disposable income, and indebtedness. Additidinal

variables were generally unimportant. Such information may be useful in the formulation of testable hypotheses regarding consumer behavior, but this analysis is just a prelude to econometric research on consumer demand for durables.

I turned to the theoretical piece, "A Model of Household Investment in Financial Assets," by Miller and Watts, hoping to find a discussion of the specification problems underlying studies such as that of Crockett and Friend, but the authors literally get no farther than stating the problem. Granted, formulating the consumer's dynamic decision problem can raise perplexing issues; but to lead the reader through 22 pages of mathematical jargon without so much as establishing a theorem or deriving a demand function is unreasonable. Perhaps their research effort will eventually lead to a major contribution in this difficult area, but this publication is premature.

Part IV, "Producer Durables," contains papers by W. H. Locke Anderson and by Phoebus J. Dhrymes and Mordecai Kurz, with comments by Henry A. Latane, R. W. Resek, and William Vickrey.

In "Business Fixed Investment: A Marriage of Fact and Fancy," Anderson attempts to demonstrate that both the acceleration principle (fact) and financial variables (fancy) are needed to explain annual aggregate investment expenditures over the 1948-63 period, excluding 1957 (a year of "collective madness," according to Anderson). His investment function includes output, capital stock, noncapital assets less liabilities plus retained earnings, a dividend-price ratio for industrial stocks, and an industrial bond yield. The relations reported fit well, and the coefficients of all the variables are of the correct sign and highly significant—and fact and fancy begin the honeymoon.

Dhrymes and Kurz also demonstrate their cunning with Cupid's bow in "Investment, Dividend, and External Finance Behavior of Firms." Maintaining that "a deficiency in the econometric investigations of the investment aspect of the firm's behavior is that the interaction of investment with certain financial variables was substantially overlooked," they postulate a four-equation model of the firm: an investment relation, a dividend equation, an external finance equation, and a budget constraint stating that investment plus dividends must equal after-tax profits plus depreciation plus external finance. The model is fitted by three-stage least squares to cross section data on 181 industrial and commercial firms for each year in the period 1951-60. In addition to confirming the accelerator's role in the investment relation and the profit rate in the dividend relation, the estimates indicate that dividends exert a negative influence on investment, that dividends are in turn somewhat negatively affected by investment, and that external finance is related positively to investment. Thus, it appears that the firm's investment decision is indeed related to, and interacts with, its major financial decisions. All three discussants express apprehension over the authors' practice of deflating investment and dividends by current sales; the cavalier defense offered by the authors scarcely does justice to the seriousness of this point. And their exchange with Resek concerning the constant term in their investment relation is in error on an essential point: an acceleration model for gross investment

*should* contain both the rate of change and the level of sales, provided that capital stock is not included.

Part V, "Anticipations," consists of papers by Reynold Sachs and Albert G. Hart and by Michael C. Lovell, with comments by Millard Hastay, Robert Eisner, James Morgan, and Victor Zarnowitz.

In "Anticipations and Investment Behavior: An Econometric Study of Quarterly Time Series for Large Firms in Durable Goods Manufacturing," Sachs and Hart assess the usefulness of the National Industrial Conference Board's data on appropriations in explaining investment expenditures over the period 1953-63. The results are only slightly favorable. While expenditures are nicely explained by a distributed lag on appropriations, they are explained equally well by a behavioral model containing lagged values of the ratio of new orders to capacity and lagged cash flows. Inclusion of the backlog of unspent appropriations in the latter relation does, however, improve the fit somewhat. Sachs and Hart admit that they have worked over these data pretty thoroughly, so the significance of the reported statistics is open to question.

The central feature of aggregate inventory cycle models is the possibility of unintended inventory changes. Firms are assumed to set production schedules on the basis of expected sales; if sales are forecast incorrectly, inventories will have to be drawn down or built up, thus diverging from their desired levels. While past empirical evidence has generally supported this view, Lovell presents some new and disconcerting findings in his paper, "Sales Anticipations, Planned Inventory Investment, and Realizations." Previous studies in this field have been handicapped by inadequate data on sales expectations and planned inventory investment, but since the fall of 1957 the Office of Business Economics has gathered quarterly information on both of these variables. Using the OBE data through 1963, Lovell discovers that (1) errors in firms' sales forecasts are far smaller than those found in previous analyses of such anticipatory data, and (2) production plans appear to be flexible enough over a three-month period for firms to avoid undesired inventory changes when sales forecasts are in error. Eisner suggests that both of these findings might simply result from a peculiarity of the data. What the OBE calls sales anticipations are actually made known in the middle of the quarter to which they apply and may therefore be as much reflections of actual sales as they are of anticipations. Thus, it may be possible to salvage the conventional view after all; but continued work on these data and, perhaps, some modifications in OBE data collection procedures are needed before this vital issue can be resolved.

Despite the very uneven quality of these papers, I think that the volume as a whole is moderately successful. Major new findings or new avenues of research on investment behavior are to be found in several of the studies. One topic, however, seems to me to permeate the volume—the controversy over the relative importance of financial variables (cash flow, interest rates, leverage, etc.) and real variables (household formation, output, capital stock, etc.) in investment behavior. Desired capital stocks may depend on what investors view as the long-run cost of funds, which enters into the implicit



rental price of capital, as Jorgenson has shown. Beyond this, any further role for financial considerations must have to do with the shorter-run determinants of adjustment speeds. Models ought to be constructed in such a way that these two possible influences are accounted for and hopefully can be distinguished. If a financial variable such as cash flow affects only the timing of investment expenditures and not the level of desired stocks, then what sense does it make to estimate relations which imply that if desired and actual stocks are equal, net investment will still be undertaken because cash flow is positive? So many of the investment relations presented in this volume have questionable implications such as this. The controversy over the role of financial variables can be settled only by estimates of relations that are very carefully specified.

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*Macro-Economic Theory: A Mathematical Treatment.* By R. G. D. ALLEN.  
New York: St. Martin's Press; London: Macmillan, 1967. Pp. xii, 420.  
\$10.00.

Professor R. G. D. Allen has earned a well-deserved reverence among economists for his systematic and successful campaigns to upgrade the mathematical literacy of the profession. In this new book Allen assumes that we have learned our previous lessons and he now guides us through a mathematical survey of modern macroeconomic theory. He is a better teacher of mathematics than he is an expositor of economics, and the present work therefore has its limitations. Nonetheless, the work will be of considerable use as a text for advanced undergraduates and it will be of great assistance to graduate students and professional economists as a reference work and guide to macroeconomic model construction.

The book is divided into four parts. The first, described as "tools," presents a brief review of the building blocks of income and growth theory. There are chapters on the consumption and investment functions, on production functions and technological relationships, as well as an illuminating chapter on the methodology of economic dynamics. Part II provides a review of the theory of income and employment. Included are surveys of the classical and Keynesian systems, a discussion of fiscal policies, and a chapter on dynamic multipliers.

The heart of the book—certainly the most carefully worked out—is the third part, which is devoted to growth economics. The analysis commences with a general discussion of problems of capital accumulation and simple Harrod-Domar models. There then follows a very instructive chapter on two-sector growth models under conditions of fixed proportions. Technical progress is introduced subsequently and various forms of technical progress are defined. The discussion then leads into neoclassical models of the disembodied technical change variety, and it proceeds from there to a survey of vintage models. The section closes with a review of Kaldor's so-called "Keynesian" models of growth.

In Part IV Allen attempts to integrate trend and cycle. The section is highlighted by an illuminating treatment of economic regulation, continues with a brief review of multiplier-accelerator models, and terminates with a chapter on models of cyclical growth.

The major strength of the book is its systematic treatment of growth models. Working up from Harrod-Domar models, on to neoclassical theory, then to vintage models, and finally to models of the putty-clay variety, Allen emphasizes the importance of different assumptions upon the determination of the equilibrium growth rate. Having conscientiously followed the discussion, the reader should be ready to put together any combination he likes, whether it involve a classical saving function with a Cobb-Douglas production function and disembodied technical change, or a Keynesian saving function in a vintage model characterized by putty-clay or clay-clay technology, or any of the other myriad combinations that modern growth theorists have been able to concoct.

The book is not without its weaknesses. Parts I and II come across as having been written hurriedly in an impatient effort to get on to the more interesting topics to follow. Allen has attempted to provide tools in these Parts, but this attempt must be accounted a failure. Mathematical literacy on the part of the reader is assumed; and Allen's emphasis is on the economics. However, the economic content of the results is rarely explored except in the most perfunctory manner, and for the most part, conclusions are little more than mathematical consequences of hastily set forth assumptions. The result is that a reader who is not up to the mathematical standards required will draw no benefit from the work; while the reader who knows his mathematics but is short on economics, will not learn much economics even though he may be able to follow the mathematical argument. The chapters on the Keynesian and classical systems are particularly unsatisfactory in this respect. Nobody is going to learn very much about Keynes from this treatment.

Even the Part on growth economics is far from ideal. The main emphasis is on the properties of "equilibrium," or "Golden age" growth, which Mrs. Robinson long ago described as a "mythical state of affairs not likely to obtain in any actual economy." There is, to be sure, occasional analysis of disequilibrium, but such questions as the speed of adjustment to the golden age are not discussed. Even though the emphasis is on equilibrium growth, the matter of maximizing per-capita consumption—finding the "golden rule"—is for some inexplicable reason not mentioned. It would have been interesting to know whether acts of God that destroy parts of the capital stock make any difference in the long run (and how long is long?) and whether neoclassical theory has anything to contribute to the issue of whether foreign aid provides more than short-range benefits. One might, finally, have hoped for some economic interpretation of why the saving rate has no effect on the golden age growth rate, and how variations in the saving rate affect the growth rate in the short run under alternative technological assumptions.

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## History of Economic Thought

*The Collected Works of John Stuart Mill*. Vols. II-III: *Principles of Political Economy with Some of Their Applications to Social Philosophy*. Vols. IV-V: *Essays on Economics and Society*. By JOHN STUART MILL. Textual Editor, J. M. Robson. Toronto: University of Toronto Press; London: Routledge & Kegan Paul, 1965, 1967. Pp. xciv, 1166; lv, 847. \$50 the complete set.

These four handsome volumes afford impressive testimony to the flourishing condition of research and scholarship in the history of economic thought, despite the continued decline in its pedagogical role in the training of economists. Moreover they provide convincing support for Professor Bladen's claim, in his editorial introduction to the *Principles*, that the latter process has already gone too far.

It need hardly be emphasized that Mill's economics formed part of a comprehensive intellectual system, and subsequent volumes of this edition will cover his contributions to Logic, Philosophy, Ethics, Literature, Politics, and Current Affairs, in addition to his Autobiography and his later letters. Two volumes of *Earlier Letters 1812-1848* have already been published. Thus the scope of this editorial undertaking resembles the current editions of Jeremy Bentham's and Walter Bagehot's *Works* rather than the recent more narrowly economic editions of John Rae and Leon Walras, or the current series of Scottish Economic Classics—of which only the Sir James Steuart and James Mill studies have so far appeared.

Even in these four volumes, which comprise the most economic of Mill's writings, the twentieth century specialist encounters an astonishing variety of topics and themes, a fact that inevitably poses intractable problems of editorial classification. The *Essays on Economics and Society* include papers on "Corporation and Church Property" (1833); "The Law of Partnership" (1851); "Endowments" (1869); and "Land Tenure Reform" (1871); and while a pedantic reviewer may easily suppress the impulse to question their place in these volumes, he is only too well aware that they can only be judged as parts of a larger whole.

The all-embracing scope of Mill's accomplishments undoubtedly conveyed to his readers an impression of omniscience which, despite his modesty and dislike of dogmatism, helps to explain why the next, somewhat mediocre generation of English economists were "men of one book"—to cite H. S. Foxwell's well-known complaint. The textual editor's painstaking collation of variant readings of the *Principles* suggests another reason, apart from the innovator's natural hostility to the ruling orthodoxy, why Jevons so furiously attacked "the noxious influence of authority" in economics in the early 1870s. Despite the important and much-discussed changes in Mill's social and political ideas, first impressions of the variant readings suggest that the main structure of Mill's economic analysis changed remarkably little throughout the seven editions of the *Principles* published in his lifetime. The overconfident section on value theory, which especially concerned Jevons, is a

case in point; and another is Mill's dramatic recantation of the wages fund theory in 1869, which he did not see fit to mention in the 1871 edition because its results were "not yet ripe for incorporation in a general treatise" (*Principles*, Preface to the Seventh Edition). There were, of course, numerous changes of detail and formulation in Mill's economic analysis; and the editor has wisely included Mill's important correspondence with Cairnes in 1864-65 concerning the revision for the sixth edition. But despite innumerable changes of wording, and modifications designed to bring the discussion of current issues up to date, the only parts where Mill's changes were extensive enough to demand separate collation in appendices were those involving "Property," "Cottier Tenacy," and "the Probable Future of the Labouring Classes"—subjects dear to Mill's heart. Also in this edition three of his 1847 articles on Landed Property are reprinted at the end of Book II, while his (not very revealing) correspondence with Harriet Taylor about the *Principles* appears as an appendix to Volume III.

Yet despite the stability of the main structure of Mill's economics, he was not merely summarizing and synthesizing the classical system, as so many of his late nineteenth and early twentieth century critics maintained. His significant additions to international trade theory have long been acknowledged, and more recently Professor Stigler has incisively demonstrated some of his other claims to recognition by economic theorists.<sup>1</sup> Mill's analytical power, which was of a kind rarely found in conjunction with historical insight and deep understanding of social policy, is abundantly revealed in his *Essays on Some Unsettled Questions of Political Economy* (1844), long passages from which were reproduced in the *Principles*. These essays constitute the most valuable part of the new collection of *Essays on Economics and Society*. Other parts include a group of five papers on currency and banking topics—which represent Mill's contributions to contemporary debates, and amplify some of the amendments to later editions of his main treatise; four papers on taxation and expenditure; some brief reviews; and various other essays which can be grouped under the headings of labor, socialism and property. Lord Robbins has written an instructive guide to this material in his editorial introduction to Volumes IV and V, while here, as in the *Principles*, the textual editor's contribution is of the highest order. Each pair of volumes contains a most helpful textual introduction and a bibliographic index of persons and works cited, in addition to the general index. Not only the individual editors, but also the editorial committee appointed by the Faculty of Arts and Science of the University of Toronto must be congratulated on this superb addition to economic scholarship.

But what, one may enquire, is the value of this undertaking to the professional economist in the 1960s? The precise answer must, of course, be a matter for individual judgment; but certainly Mill's work is of much greater significance now than it was in the neoclassical and early Keynesian genera-

<sup>1</sup> "The Nature and Role of Originality in Scientific Progress," *Economica*, Nov. 1955, N.S. 22, 293-302; reprinted in *Essays in the History of Economics* (1965). Surprisingly enough, this is not mentioned in Bladen's editorial introduction to the *Principles*.

tions. As Bladen notes, much of the meaning of his economic theory is lost unless it is seen in the context of "full development"; and had he been born a century later Mill would surely have agreed that economic development is too important a matter to be left to the economists. He was invariably conscious of the political and institutional environment in which economic change takes place, and he displayed a continuing interest in the sociocultural dimensions of the process. He was at times a preacher who hoped that his *Principles* might, like the *Wealth of Nations*, impress itself "strongly on the minds of men of the world and of legislators" (Preface to the first edition); and although it was, in general, a "measured polemic" (II, p. 1xxix), numerous passages are enlivened by Mill's personal enthusiasms. As a concluding estimate it would be difficult to improve on Lord Robbin's comments on the "spirit" of Mill's work in his introduction to the *Essays*: ". . . for a generation disillusioned with systems, he once more appears as a highly admirable figure; a man with a firm hold on the ultimate values of truth and justice and liberty, with strong principles and a strong belief in their applicability; yet, once the high spirits and arrogance of youth had been transcended, fair in argument, willing to learn by experience, empirical in judgment, experimental in action" (IV, p. xli). This is his legacy to our time.

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*The Age of Keynes.* By ROBERT LEKACHMAN. New York: Random House, 1966. Pp. vii, 324. Paperback edition, \$2.50.

Robert Lekachman's *The Age of Keynes* is a lucid, accurate, and useful statement of the life, times, and thought of John Maynard Keynes, who is characterized as the greatest economist of the twentieth century. The first seven chapters sketch Keynes' career from his birth in Cambridge, England, in 1883 to his death in 1946. The biographical portion of the book is based on Roy Harrod's great biography and E. A. G. Robinson's well-known obituary rather than upon new research and adds nothing to the existing knowledge about Keynes' career. Two chapters on *The General Theory of Employment, Interest and Money* (1936) provide an excellent survey of Keynes' most important work. None of this will be new to professional economists, but the book is a neat package to place in the hands of college sophomores to give them a general perspective on the main currents in economic theory and policy over the past three decades. The New Economics is identified with Keynesian Economics.

The final four chapters entitled "The Keynesian Era" are essays on growth, automation, inflation, and the tax cut of 1964 as the ultimate triumph of Keynes' basic idea. Much of this material is only remotely related to Keynes and is often more revealing of Lekachman's views on contemporary economic problems than of Keynes' thought. Lekachman is highly critical of the Eisenhower Administration's economic policies which fostered low growth

rates and relatively high unemployment. The chapter on automation is not very relevant to Keynes and fails to make the point that Keynes had virtually nothing to say about the economics of technology and that he assumed away the question of structural unemployment by treating all labor as homogeneous in its general qualities. The crux of structural unemployment is, of course, the heterogeneity of labor inputs.

In order to curb price inflation Lekachman would supplement Keynesian monetary-fiscal weapons with guide posts for wages and prices. President John Kennedy's assault on the United States Steel Corporation in 1962 is applauded as illustrative of what may be accomplished by a vigorous antitrust policy to limit the exercise of market power by oligopolistic business giants. Lekachman laments the policy, characteristic of the United Kingdom and more recently of the United States, of meeting financial crises in the international balance of payments by slowing down economic growth and creating unemployment through increasing interest rates and taxes. He suggests that if Keynes' International Clearing Union had been accepted at Bretton Woods in place of the International Monetary Fund the world would have been spared many of the agonizing international financial problems of the postwar period. The Special Drawing Rights, toward which the international Monetary Fund has been moving recently, represent belated recognition of the wisdom of Keynes' position.

Lekachman's justification for the title, *The Age of Keynes*, is his assertion that Keynes was "the greatest economist of his age" (p. 8). Most professional economists will, I believe, acquiesce in this judgment and few will have alternate candidates. Yet Lekachman never addresses himself critically to the question why, if true, Keynes did become the greatest economist of his time, or more generally, what are the requirements for becoming so great an economist that a whole era will bear his name. A review of Keynes' career and personality reveals some strange characteristics in view of his place among the all-time greats in the history of economics. Keynes did not devote himself single-mindedly to economics at any time in his career. He held neither a doctorate nor a professorship in economics. Keynes' posthumously published essay, "My Early Beliefs," leaves the definite impression that his basic interests were in philosophy, the arts, and other immaterial subjects far removed from mundane economics. In an age in which mathematics is the handmaiden of economic theory, how can a man who deprecated the use of mathematics in economics (*General Theory*, pp. 275, 297-98) be the greatest economist? Paul Samuelson has said that Keynes was antipathetic not only toward the use of mathematical symbols but also toward economic theory in general and seems never to have had any genuine interest in pure theory (*Econometrica*, July 1946, pp. 196-97). So what is so great about Keynes as an economist?

Better than anyone else Keynes met the challenge presented by the Great Depression and all that it implies as a major crisis in the history of modern capitalism. Meeting this challenge required an unusual combination of natural ability, nonconformity, insight into contemporary history, and a capacity to

express theory in operational concepts which can be acted upon by statesmen and economic administrators.

In probing for answers to practical questions Keynes first tested the old (classical) theory as a basis for giving advice and found that it did not work. So he demolished the classical edifice, with its laissez-faire implications, mainly by attacking Say's law in relation to money, interest, and employment. Then came the erection of a new edifice, a macro system of theory couched in terms of investment, consumption, national income, and employment. These concepts are built into a coherent *system* which enables economic administrators to know what to do about high unemployment, low growth rates, and inflationary increases in the general price level. Keynes' economics combines tools of analysis, guides to action, and essays in persuasion. There remains the hard test of the workability of the policies implied by the operational concepts of theory, that is, the question of the validity of the theory as tested through the workability of policy. By and large Keynes' economics met this critical test. Many refinements remained to be worked out by more patient men. For example, the question of whether Keynes' theory is one of equilibrium or disequilibrium at less than full employment is important for technicians but not important in the long sweep of the history of economic thought nor in determining after whom the age shall be named.

Nothing Lekachman says is inconsistent with this interpretation of Keynes' greatness, but in neglecting these more general and more basic issues he missed an opportunity to give his book the greater significance it might otherwise have.

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*Scholasticism and Welfare Economics.* By STEPHEN T. WORLAND. Notre Dame and London: University of Notre Dame Press, 1967. Pp. x, 298. \$7.50.

This is definitely not an easy book to review. Indeed, the major defect of Worland as a writer is that the clear lines of development, promised in the Preface and implied in the Table of Contents, do not materialize in the pages. This is not a book in which the reader can read the first and last chapters for premises and conclusions and then work through the body of the book to check on content and argument.

First, let us be sure what the book is *not*. Ever since Adam Smith was proclaimed by certain historians to be the father of modern political economy or of scientific economics, there has been a clear challenge to other historically minded persons to search for anticipators. Worland's claim is that scholastic philosophy (by which he means Thomas Aquinas and a few twentieth century commentators) does not anticipate but has something to offer as a complement to modern welfare economics. He finds equivalents in the concepts and approaches of the two systems (this, of course, requires a fairly elaborate exegesis) and thus argues that through the synthesis of the two systems it would be possible to come up with a welfare economics that is grounded in practical ethics and elaborated with the scientific method of modern economics.

Worland is thus in contrast to such writers as the late Bernard Dempsey. To Dempsey, scholasticism had developed a sound basis for economic theory which, in effect, Adam Smith destroyed.

Now let us try to see what the book is. Worland's claim is "that the theorems of welfare economics turn out to be the joint product of both scientific economic analysis and scholastic moral values . . . the conclusions of welfare economics appear as corollaries of the natural law—propositions of the *jus gentium* to be clearly seen and appreciated only when the principles of natural law are connected with economic science" (p.v.). Modern welfare economics provides the "missing link" between the just price doctrine and the common good as developed by scholasticism; the social welfare function reconciles distributive justice with justice in exchange (pp. vi-viii). As the author himself explains the table of contents, the first two chapters are devoted to examining St. Thomas Aquinas's moral philosophy and thus developing the scholastic version of the foundations of welfare economics; Chapters 3 and 4 form a history of welfare economics from Adam Smith to the present day; the next two chapters are an effort to explain some of the concepts of welfare economics to noneconomists and thus show terminological equivalents; Chapter 7 tries to reconcile philosophic rationalism and voluntarism into what is to be called a "natural law" system; Chapters 8 and 9 find the complementarity between scholasticism and modern welfare economics basically in terms of the just price and the common good.

How successful is Worland in carrying out his design? First of all, what about his analysis of "scholasticism"? Joseph Schumpeter was much interested in "scholastic" economic analysis, but the dissertations he inspired were devoted mostly to sixteenth century moralists rather than to the thirteenth century Thomas Aquinas. Aquinas produced such a small body of comment on economic and business activity that Worland could be accused of selecting an author into whom it would be easier to read his own preconceptions. But was St. Thomas somehow the overpowering intellect for later "scholastics" so that what flowered in their writing was somehow programmed genetically in the *Summa*? I believe historians of scholastic philosophy would agree that Thomas Aquinas wielded much more authority in dictating official Catholic philosophic positions in the first half of the twentieth century because of such popes as Leo XIII and Pius XII than he ever did before the Enlightenment of the eighteenth century. Secondly, the author's simplification of modern welfare economics will certainly not be accepted entirely by the writers themselves nor the professional students of those writers.

But apart from questions of interpretation, does this book have something of importance to offer economists? It would be a notable achievement to anchor welfare economics to some practical ethical system. At best, Worland gives a bare outline of such a relationship. This book should be brought to the notice of a select few economists and moral philosophers, for use in their study and original work. This study is out of the ordinary, sincerely and carefully done, but difficult to evaluate by the ordinary standards of review.

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**Economic History; Economic Development; National Economies**  
*Why Growth Rates Differ.* By EDWARD F. DENISON, assisted by JEAN-PIERRE POULLIER. Washington: The Brookings Institution, 1967. Pp. xxi, 494. \$12.50.

This is a sequel to Denison's famous study of the *Sources of Economic Growth in the United States*. It uses the same analytical framework, the same estimation techniques to compare postwar growth rates for the United States and eight European countries—Belgium, Denmark, France, Italy, Germany, the Netherlands, Norway, and the United Kingdom. Like the earlier study it is an attempt to measure the sources of output growth in terms of changes in the quantity and quality of inputs and factor productivity and to draw inferences for U.S. economic policy.

Denison's numbers raise some profoundly controversial issues. For the anti-statisticians they offer fine target practice in their favorite sport of shooting down all daring estimates: the author's candid discussions of his methods and assumptions will guide their aim. For figure-happy commentators who confuse estimates with facts it offers a unique collection of consistently processed growth data for nine mature industrial countries. The area for potentially fruitful discussions which lies between these arid extremes is, however, a wide one. For these are not the kind of statistics that effectively prove or disprove anything at all, except the immense complexity of the task of defining or interpreting national growth rates. They raise more interesting questions than they answer and Denison is always explicit. Only the most naive reader could suppose that these numbers are intended to be taken at their face value.

It is impossible within the space of a short review to mention more than a fraction of the important issues and the following comments are highly selective. They take for granted the basic analytical framework of the study, the assumptions of the underlying productivity analysis, and accept that the elements into which Denison chooses to resolve the "sources" of economic growth represent an intrinsically interesting set of categories. Within these limits and considering the implications of these techniques of analysis and measurement for intercountry comparisons, the thought-provoking measures are those which seek to quantify relative quality changes in the factor inputs and to identify the causes of differing productivity trends.

After all the emphasis put on the "human factor" in the literature of economic development, it is at first sight surprising to find that Denison's numbers in this area are so small. He measures four aspects of labor input—numbers employed, hours worked, age-sex mix, and education. Intercountry differences in the growth of numbers employed are a significant cause of variations in the rate of growth of total output; but if growth is measured per head of the labor force it is only in the case of Italy that the labor inputs appear to account for as much as half of one per cent of the national growth rate; and for Germany and Denmark their net contribution turns out to be negative. The main factors on the negative side are the average num-

ber of hours worked and the age-sex composition of the labor force. On the positive side the main factor is education, measured in terms of the number of years schooling embodied in the labor force weighted by the U.S. earnings differentials attributable to different levels of schooling. So if the "quality" of labor input per person employed seems to have deteriorated, it mainly reflects reductions in hours worked per full-time man year and an increase in the participation of part-time workers or lower paid workers like women and juveniles; if it appears to have added to labor productivity then it mainly reflects a lengthening of the period of formal education adjusted, where possible, for attendance.

It is not easy to interpret these results though one can see why Denison's calculations yield rather low figures. For much of what is relevant to a comparative assessment of changes in labor force quality slips through his net. A chapter on the unmeasured elements discusses three of them at some length—experience, effort, and health—and there is clearly scope here for significant variations in trend as between countries during the period under review. Denison himself seems to favor national differences in the intensity of work as an explanation for the relatively high starting level and slow growth of labor productivity in the United States on the one hand and for the relatively low level and slow growth in the United Kingdom on the other. Moreover, the assumption that individuals with the same number of years of full-time schooling have an equivalent education in all of the nine countries considered begs a crucial question. What Denison does claim to have established unambiguously is that education (measured in terms of the number of years schooling per member of the labor force and valued by U.S. earnings differentials) increased more in the United States over the period 1950-62 than in any other country considered. The reasons for this lie in what happened before 1950 rather than after and he estimates that the educational quality of Northwest European labor was far above the American level in 1925 and roughly equivalent by 1950.

Of the other two factors of production, capital appears to contribute substantially to variations in national growth rates while the contribution of land to total economic growth is everywhere assumed to be negligible. Only in Belgium is capital estimated to be less important than labor input in determining the 1950-62 rate of growth of national income per person employed. This is in spite of the fact that Denison's calculations fail to take account of the basic quality of capital input, its age structure, or its intensity of employment. Again, however, he does not ignore these issues but discusses them thoughtfully and at length. In particular he gauges the potential order of magnitude of the effects of differences in the age structure of capital by trying to measure their contribution for what might reasonably be regarded as the extreme cases—Germany and the United States.

In the end, of course, the effects of the unmeasured changes in the quality of either labor or capital spill over into the residual rag-bag and are classified as contributions to the growth rate of output per unit of input. Because it is a residual, output per unit of input turns out to be more important than total

factor inputs in accounting for variations in the national growth rates. It is here that the significance of the intercountry comparisons becomes most elusive and Denison's attempts to identify their causes begin to strain the less imaginative reader's sense of reality. Some of his estimates are purely national. For example the annual contribution to the growth rate per person employed of "advances of knowledge" is reckoned to be almost exactly the same for each country, with the result that for the United Kingdom it accounts for almost half the measured growth in productivity. Economies of scale are measured partly on the purely notional assumption that increasing returns to scale raised the U.S. national income by 1.10 per cent and for other countries by slightly different but equally notional percentages, and partly on the assumption that differences between per capita consumption growth rates based on national price weights and those based on U.S. growth rates reflect divergences in the contribution of economies of scale to national income growth.

It is in accounting for the residual, however, that the most interesting as well as the most impossible questions arise. Those who are not accustomed to looking underneath the familiar statistical stones will probably find Denison's heroic measures positively alarming and give up building anything at all on international growth rate comparisons. Those who feel that it ought to be possible to draw intelligent policy inferences from growth rate comparisons would be well advised to start with Denison's study even if they boggle at some of his results. For there is no other book that deals so frankly and so knowledgeably with the statistical problems of identifying the nature and causes of the wealth of nations.

PHYLLIS DEANE

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*Planning and Development in Iran.* By GEORGE B. BALDWIN. Baltimore: The Johns Hopkins Press. Pp. xiv, 212. \$6.95.

*Regional Economic Development in Italy.* By LLOYD SAVILLE. Durham, N.C.: Duke University Press, 1967. Pp. xiv, 191. \$7.00.

An apocryphal story tells of a kingdom in which learned men drew intricate anatomical atlases while embalmers preserved human bodies. The exalted position of the sages prevented them from ever looking at corpses, so the intricate and refined drawings bore no relation to crass reality. Embalmers, of course, could not read nor could they make much out of the drawings. Even a quick perusal of any of a number of theoretical works on planning (such as the 1259-page volume which very appropriately appeared under the auspices of the Pontifical Academy in Rome) provides conclusive proof that our learned men are no more willing to look at the corpses than the learned men of the mythical kingdom.

In his study of planning and development in Iran, Dr. George B. Baldwin tries to redress the balance and to tell us how planning looks to the lowly practitioners of planning in underdeveloped countries. In Iran, as in most

countries in the early stages of industrialization, even the most basic economic data are lacking or are the product of somebody's fantasy. Decisions are made on the basis of personal whim or personal influence. Policies are not followed through or are reversed without any forewarning. In such countries planners can do little more than use their common sense in recommending policies and their recommendations usually fall on deaf ears. When planners achieve some measure of success, the success is due not so much to the excellence of the planning as to lucky circumstances and to the basic dynamism of the country.

Baldwin starts his account with a brief discussion of Iranian politics and of Iran's economic development in the pre-planned period. Next, he gives us an overview of the three Iranian postwar plans. This is followed by a more detailed discussion of the problems of balance of payments, of agriculture, industry, and of manpower and education. The final two chapters are devoted to a summary of the conclusions reached by the author. Understandably the author disparages the usefulness of advanced techniques for planning in countries such as Iran. He also raises a more fundamental issue, namely whether and to what extent underdeveloped countries can benefit from comprehensive economic planning.

Baldwin has an intimate knowledge of Iran, and has written a concise and well-balanced book which deals with important issues. Yet he leaves the reader with a feeling of dissatisfaction. To put it brutally, the book is superficial. Baldwin's main thesis is that planning failed because of political factors, but he never really tells us what these factors are. True, he quotes the *Economist* about Iranian politics to the effect that "anyone who really knows what is going on in Iran must be grossly misinformed," but it may be better to misinform the reader than to leave him completely in the dark. The few generalizations which are made do not explain the rise and the fall of the Planning Organization. Why the Imperial Government embarked on radical land reform in 1962 and why this reform slowed down at the beginning of 1963 is also scarcely understandable. I suspect that the author knows much more about Iranian politics than he is willing to commit to paper.

Another unsatisfactory feature of the book is that it leaves many loose ends. For instance, the land reform story breaks off in midstream in March 1963 (though a footnote brings us up to the summer of 1964). Yet, the book was finished in November 1966 and presumably the author could have checked on a few crucial developments which took place in the intervening two years.

Another weakness of the book lies in the paucity of economic analysis. The discussion of balance of payments problems in Chapter 4 is conducted entirely in real terms, with monetary factors never once mentioned. A footnote on page 13 seems to suggest that it is possible to talk people into confidence in the currency regardless of the rate of inflation. On page 127 we are told that the licensing system for textile plants worked well, but we are never told what is meant by a well-working licensing system. The economic analysis is even more threadbare when (as in the discussion of manpower planning) the author abandons specific Iranian issues to embark on a broader

treatment of planning. Yet all these weaknesses are relatively minor. Baldwin wrote a good book, which should be read by those interested in the practical side of planning.

I do not really know how to place Saville's book on regional economic development in Italy in my twofold classification, since the author seems to be equally unaware of economic theory and of practical policies. Indeed, with the exception of its commendable brevity, the book is an example of how not to write a book on economics.

The book starts out by contrasting "stratified layers of refuse embedded in the floors by the sketchy housekeeping of successive generations of Villanovian housewives . . . with the high gloss achieved by the regular application of polishing pads by modern housekeepers." Most of the statistics presented, however, refer to a much more modest span of history, namely the 1951-1961 period. However, the Villanovans (and also the Etruscans) get called in whenever they are needed to help explain some otherwise puzzling differences in post-World War II development of various Italian regions. Good use is also made of religious and social factors. For instance, on pages 78-79 we are told that *Rerum Novarum* is partially responsible for the decline of the rate of labor participation amongst Sicilian women. Somehow, however, *Rerum Novarum* made no impression on the women in the Northern provinces, and even in Sardinia where, as we are told on page 112, women's participation has increased since the unification of Italy.

Saville sets himself the task of a detailed analysis of regional differences in growth patterns of Italy. In Part I he sets out to define regions in a more meaningful fashion than those obtained by the arbitrary division into North, Center, and South. In its place he proposes a seven-region breakdown, and then proceeds to select typical provinces from each of the regions. Unfortunately, the provinces which he selects are in many ways very atypical. For instance, Cuneo is selected as a typical North-Western province. However, as we are told on page 27, the population density per square mile in the Northwest as a whole increased by 162 per cent in the 1871-1961 period whereas in Cuneo it decreased by 25 per cent. Another example is Brescia, which is taken as a typical province of the Northeast region. Here the road density actually decreased in the relevant period, whereas in the area as a whole, it increased enormously. Needless to say, the author shuns variance analysis which might show whether the breakdown into regions is meaningful and whether the selected provinces are in any way typical of the regions. As it turns out, however, division and selection of typical provinces is of little consequence, since the author makes no attempt at a systematic use of his own classification in actual comparisons.

In the second part, the author attempts to link the rate of development to such factors as average population densities, the structure of the labor force, wage levels, the supply of capital, and others. There are some interesting findings as, for instance, the finding that the density of population is positively correlated with the rate of growth of income, but not with the income level. Much of the work relies, however, on secondary sources which, though interesting, are not very trustworthy, such as Professor Tagliacarne's calcula-

tions of per capita income in Italy's region in 1938 and in 1951-60. Tagliacarne's calculations are of great importance to the understanding of Italy's development, but, as explained in the original publications, they are largely based on fragmentary evidence and should be used with extreme caution, which Saville fails to do.

Because of the confused nature of the book, it is really extremely difficult to say what the whole book is about. At some points comparisons are made between one small and well-defined region and another. At other times Germany is compared with Italy. The time span jumps from prehistory to postwar history, the subject from women's participation in the labor force to the results of investment programs for Southern Italy. Inevitably, none of the subjects is well covered or well documented. For instance, the discussion of development programs for Southern Italy fails to mention Chenery's studies. I.M.D. Little's name never appears in connection with the discussion of the fuel situation.

The author's syntax provides some comic relief from the book's confusion. Here are two gems: "To increase a nation's rate of economic growth by even a tenth of a per cent per year is notoriously formidable" (page 40). "In comparison with the three-region figures of the Central Institute of Statistics both Cusimano's and Tagliacarne's distributions tend to be somewhat greater than official estimates" (page 39). The few moments of jollity which such passages provide are a poor excuse for writing the book and a poorer excuse for reading it.

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*Economic Development Issues: Latin America.* Prepared for the Committee for Economic Development. New York: Frederick A. Praeger, 1967. Pp. xix, 341. \$10.50.

*Reflections on Latin American Development.* By ROBERTO DE OLIVEIRA CAMPOS. Austin: University of Texas Press, 1967. Pp. xii, 168. \$5.00.

These two books reflect the gradual coming of age of economic analysis and statesmanship in Latin America. They are a diagnosis of the present economic situation by leading economists and policy-makers of some of the more important countries. One book is a collection of recent essays and speeches by one of Latin America's most brilliant economists and diplomats, Dr. Roberto de Oliveira Campos. The other is a compilation of country studies, commissioned by the U.S. Committee for Economic Development. Each of the six studies (Argentina, Brazil, Chile, Colombia, México, and Perú) is an introduction to some of the economic and policy problems of the country.

Dr. Campos, in his twelve essays, ranges over the entire field of Latin American development problems, including historical relationships, U.S.-Latin American relations, government policies, administration, management and entrepreneurship, social engineering, trade and aid, Brazil's unique situation, and the Alliance for Progress. The audience to which Dr. Campos addresses

himself consists generally of noneconomists and those not specialized in Latin America. There is a considerable amount of repetition since there was no revision before putting the essays in book form.

Dr. Campos' basic theme is that historical perspective, good will, open markets, democratic governments, institutional reform, and ample and liberal credit will put Latin America on the road to development. His criticism of the U.S. and Latin American governments is more gentle than that made by most students. He refuses to ally himself with either the structuralists or monetarists and pursues a moderate, middle-of-the-road course.

It must be said, however, that Dr. Campos' world is extremely orderly. Nearly every phenomenon consists of two, three, or "X" elements. The two main aspects of the Latin American politico-economic landscape are: (1) the antimilitary and antidictatorial trend, and (2) the mystique of development. The three elements of Latin American ideology are (1) bias against primary production and in favor of industrialization, (2) bias in favor of state intervention, and (3) tolerance of inflation and unbalanced growth. The two inner contradictions of its ideology are (1) the demonstration effect, and (2) nationalism. The two kinds of nationalism are (1) romantic and (2) pragmatic nationalism. There are three planes of action: (1) nationalism of ends, (2) internationalism of means, and (3) supranationalism of markets. These are random samples. These taxonomic exercises are very interesting, sometimes useful, but nearly always wrong, or at least too simple.

Let us not be deluded, however, into thinking that Dr. Campos is trapped by his own sometimes oversimplified constructions. His experience as diplomat (Brazilian ambassador to the United States), as policy-maker and planner in the Castello Branco government, and as teacher gives him certain license when making speeches. Dr. Campos' central message is moderation and discipline: moderation in the form of pragmatic nationalism, state intervention when it improves the productivity of the factors of production, and reform from within; discipline in the management of fiscal and monetary affairs, in the operations of government enterprise, in planning, and in policy determination.

In the CED-sponsored book Roberto Alemann writes on Argentina, Hernan Echavarria on Colombia, Rómulo A. Ferrero on Perú, Gustavo Romero Kolbeck on México, Sergio Undurraga Saavedra on Chile, Mário Henrique Simonsen on Brazil. These are all well-known and respected economists and policy-makers in their respective countries. The CED, of course, placed no restrictions on the authors, but the commissioning of these authors and the selection of these countries by the CED may have resulted in an unconscious bias. The reader will not find either leftist or CEPAL thinking in these essays. The result is a compendium of "orthodox" analyses and prescriptions, markedly different from that which would be found in a random sample of economists and policy-makers.

These are, of course, not complete country studies. For example, the study on Argentina is an attack on the government's policies from Perón to the present. The Chilean study deals in a balanced way with three elements of its

development: copper, agriculture, and education. The Colombian study is another assault on government policy, with especially harsh words for a nonexistent "proyectista" school of public investment. The study on México offers a healthy antidote to the Colombian study, pointing out that the government building of infrastructure laid the groundwork for substantial progress by the private sector. The Peruvian study is a straightforward country study, with overtones of criticism of government policy. The Brazilian study is the best. It demonstrates, as does Dr. Campos, the possibility of the coexistence of a high rate of inflation and a high rate of real economic growth under certain circumstances. Simonsen shows, however, a fact not mentioned by Dr. Campos. The process of simultaneous inflation and growth has been possible only by the rapid substitution of public investment in sectors which had been functioning effectively in private hands.

The chief mischief-maker in most of the studies is inflation and the chief cause of inflation is "unsound" fiscal and monetary policies, including deficits financed by printing press money, taxes which act as a depressant on the private sector, and inadequate foreign economic policies. Directly and indirectly the "false" doctrines of the "structuralist" and CEPAL schools come in for a thorough thrashing in many of the studies. There is little criticism of the private sector and virtually no criticism of the United States, its policies, or of U.S.-dominated companies. This is all a bit too good to be true, and makes it clear that the studies were inspired and written from the point of view of the private sector. This, of course, does not render them scientifically invalid, but it must be borne in mind that in some cases they represent only a partial view. In all of these countries, there are book-length studies which are better balanced and more acceptable analyses.

For students of Latin American affairs, a collection of Dr. Campos' essays is a welcome addition to the literature. Even its simplistic nature does not mar the contribution. For those not familiar with Latin American economic affairs, Dr. Campos is a good place to begin, but it must be supplemented by a rapidly growing literature in this field. For anyone, the CED volume should be read at least in conjunction with Dr. Campos' work, and preferably with some more complete country studies.

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*Economic Policy in Postwar Japan: Growth Versus Economic Democracy.*

By KOZO YAMAMURA. Berkeley and Los Angeles: University of California Press, 1967. Pp. xvii, 226. \$6.95.

It is a pleasure to welcome Professor Kozo Yamamura into the exclusive Sour Grapes (*Suppai Budō?*) Club of Western and Westernized economists faulting Japan's postwar economic miracle. As we can guess from his subtitle, Yamamura's criticism is that Japan has sacrificed free competition, fiscal and distributional equity, and current economic welfare for pottage points of measured economic growth and (possibly) future economic welfare. In Harrod-Domar terms of  $Y_t = Y_e^{at}$ , Japan has raised  $Y_t$  primarily



by the multiplier ( $\alpha$ ) effects of investment in excess capacity (private pyramid-building), while minimizing by export-stimulation any offsetting fall in its productivity ( $\sigma$ ) and maintaining the profitability of the whole operation by holding down the labor share of the national income. (Compare this reviewer's Chapter 11 of W. W. Lockwood's *State and Business Enterprise in Japan*.)

Yamamura's monograph stems from a doctoral thesis in industrial economics, so that its primary stress is on issues like industrial structure, concentration and monopoly, and the "falling rise" of the *zaibatsu*. Chapter 9, on taxation, and Chapter 10, on labor and wages, seem to be afterthoughts. The concluding Chapter 11 presents a broad spectrum of rival Japanese views on the entire problem of "Choice versus Growth."

The first seven chapters, while spattered from the dissertation inkhorn, are more detailed and useful than the rest. Yamamura traces the confused and contradictory history of SCAP's advance and retreat from *zaibatsu*-busting, without answering forthrightly the 64-billion yen question, whether a competitive Japan could also have performed economic miracles while maintaining economic independence from the United States. The subsequent Japanese "promonopoly" policy Yamamura distinguishes from *zaibatsu*-restoration because (1) so many new giants are not old-*zaibatsu* affiliates, and (2) because linkages between these affiliates are more tenuous than prewar ones; control is now divided between management, stockholders, banks, and public agencies.

Yamamura also shows that most industrial concentration ratios of the standard "Big  $n$ " variety have tended to decline over time, while "concentration" was rising in the sense that small firms were forced into mergers with larger ones, or into satellitic dependency upon the larger firms. One gathers that the Ministry of International Trade and Industry (MITI) encouraged all "large firms" able to take advantage of advanced technology, and encouraged them even at the expense of smaller ones, but that in most industries these large firms numbered more than  $n$ —hence the apparent anomaly. It would have been interesting to see Gini concentration ratios (covering the entire distribution of firms) along with the conventional "Big  $n$ " ones.

A merit of these chapters is their extensive sampling from Japanese sources, including the emotional left-wing writers not usually deemed worthy of translation. Offsetting this merit, Yamamura omits some recent Western literature; the essays of Eleanor Hadley and Eugene Rotwein are among the missing, considering only contemporary American writers on Japan's industrial structure.

Yamamura's taxation chapter does not delve deeply into incidence problems, and weakens its own case by omitting the "inflation tax" which has shifted so much of the cost of growth in the 1960s to persons "locked in" to income and wealth in monetary form. The labor and wages chapter could also be strengthened by considering the relative share not only of industrial labor—biased upward, since such labor is a rising portion of the labor force—but of the entire "proletariat," including the small farmers.

Both these chapters abound in statistical tables, not always debugged of inconsistencies.<sup>1</sup> The summary "opinion survey" Chapter 11 overreacts from Japanese Marxism to exaggerate the low-level strains in the holy (?) alliance between Big Business and *Jiyutō* (Liberal-Democratic Party) Japanese Government. It also exaggerates, alas, both the vehemence and the influence of Japanese "modern economists" to the existing official growthmanship-preference.

There is a good index, and the bibliography is rich in Japanese sources. The University of California Press, however, gets poor marks for editorial efficiency, having left Yamamura's English marred by occasional traces of *Eigo* and "Japlish." One more "stylistic" reading would have helped the monograph substantially.

M. BRONFENBRENNER

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*Economic Development in Asian Perspective.* By SHIGERU ISHIKAWA. Tokyo: Kinokuniya Bookstore Co., Ltd., 1967. Pp. 488. 2,800 yen.

I opened this book with high expectations, since its aims are ambitious and it has been well spoken of. In fact, while I found it insightful and informative on certain matters, particularly in the area of agriculture, it did not live up to those expectations.

The theme of the book is that the initial conditions of development in Asia today are markedly different from those in the presently developed countries when they began their rapid development and that these differences require a different pattern of future growth from what was applicable in the past. The book explores the differences and develops a pattern of growth for Asia on the basis of these differences. These differences are: (1) The low level of per capita incomes in Asia compared to those in the West or Japan at comparable periods. (2) The comparatively high rate of growth of population and labor force in today's developing countries further exacerbating a condition of surplus labor supply. (3) The largely subsistence character of agriculture characterized by the virtual disappearance of the arable land frontier and a lack of basic investment in infrastructure, especially in the area of water control. This in turn contributes to a very low per capita farm output and consequently an even lower marketable surplus which greatly limits the possibility of industrialization. (4) In the industrial field modern technology requires far greater capital investments for a particular plant than in the past, while the direct employment consequences of this investment are less. (5) In the area of foreign trade, the foreign markets for today's developing countries are restricted because of the unwillingness of the advanced countries to restructure their industrial structure according to comparative advantage. (6) Various institutional differences such as the end

<sup>1</sup> An example is pointed out by the reviewer's visiting colleague, Professor Kei Shibata "Table 49 (p. 155) shows that, over the decade 1953-63, hourly real wages, labor productivity, and the labor share grew, respectively, from 100 to 162, from 100 to 216, and from 47.7 to 53.9 per cent. However, the first two results seem to imply that the labor share *declined* to 47.7  $\times$  (162/216) or 35.8 per cent." Explanation is required, to say the least.

of colonialism, the breakdown of traditional landlord-tenant relationships, and the pressure for social expenditures and minimum wages have all contributed to a markedly different climate for development in Asia than in past development. The effect of these initial conditions is to set up a series of conflicting goals: e.g., the goal of rapid agricultural growth versus that of speedy industrialization compete for scarce investment funds; development of capital intensive import-substitution industries contributes to great demands for scarce foreign exchange with only slight employment effects. The problems of development are far more difficult than in the past and the reconciliation of these conflicting goals in Asia requires both precise analysis and a more exact model than in the past.

The author explores the implications of these various conditions, first for the development of agriculture and then of industry. In the field of agriculture the prime requirement is an increase in per acre output, since the frontier of arable land has virtually disappeared. The author develops the concept of "leading inputs," and a staged series of requirements for the increase of per-acre output. The leading input is water control which includes an infrastructure for flood-control, irrigation, and drainage. Water control requires a heavy basic investment, but it is a precondition for the new technology of fertilizer, improved seeds, new varieties, and improved farm tools. The main source of funds for the basic investment is the government, and the government also plays a major role in stimulating the adoption of fertilizer, better seeds, and better techniques. The large surplus labor force that characterizes the Asian economies makes possible some substitution between labor and capital in carrying out the basic investment in water control. However, the surplus labor also leads to a need for rapid industrialization in order to absorb the surplus labor force.

The discussion of agriculture is followed by a short chapter on the flow of resources from the agricultural to industrial sector. The author concludes that it is unlikely that in the early stages of development that there will be a flow of resources from agriculture to industry; that the government "must be prepared unhesitatingly to allocate the required amount of centralized funds to agriculture"; but that the government must exert all efforts to minimize the net resource flow into the farm sector, by appropriate techniques for the basic investments and improved organization of the farm sector.

The author then moves on to a discussion of industry; here he, in effect, adapts the so-called Mahalanobis model, used for the Indian Second Five Year Plan, to other countries. A basic result of this model is its conclusion that developing countries establish their own intermediate and capital goods industries, if they are to carry on an investment program of the required size. This rests in part on the assumption that possibilities of gaining foreign exchange by expanding foreign trade are limited by the policies of the developed countries. These capital goods industries are characterized by a capital intensive technology with relatively fixed factor proportions, for which the scale factor is very important. Such massive capital intensive investments in plants of modern technology have only minor employment con-

sequences. Therefore it also becomes necessary for the government to stimulate, both by its policy and resources, the labor intensive cottage industry sector. A criterion as to choice among industries in the cottage sector is the additional finance capable of being mobilized beyond the initial government investment. Nevertheless, government policy is the major determinant in choice of projects in both the modern and cottage sectors, and this requires careful and precise government planning.

In my opinion the book's major contribution is in the discussion of agriculture. I think the discussions of the new agricultural technology, the experience of Japan which the author knows well, the examination of the comparative experience in various developing countries, and of surplus labor, all make a contribution to the field of development—especially for a reader who is not an agricultural economist. If this were all the author aimed at I would have been satisfied with perhaps minor caveats. But the author attempted much more—and in this he did not succeed.

First, he talks often about a universal model of development; in fact the model is largely of an Indian type which I think is not relevant to many other countries (Thailand is a most obvious example). The model is basically an investment model with some adjustments to allow for the "initial conditions," and as such it has the weaknesses of all such models. Professor H. Myint in his *The Economics of Developing Countries* has especially stressed the peculiarity of India, and the weakness of the Indian model applied elsewhere.

Second, he largely ignores the use of the market in allocation of resources, or such measures as profitability or rate of return. Where the question is discussed it is in terms of "required" or "optimum" amounts, without adequate criteria for determining what is required or what is optimal. The author puts stress upon planning without specifying any precise criteria for choice when allocation problems become important, while ignoring the relation between the plan and market criteria.

Third, he too willingly accepts the thesis of limited foreign markets for the products of the developing countries. There is by now a fair amount of evidence that the poor foreign trade experience of many of these countries reflect significantly the weaknesses of their past policies, with their stress on import substitution, overvalued exchange rates, protected markets, etc. Also he underestimates the possible size of the local market and the effect of the availability of manufactured goods in rural areas as a stimulus to rural output.

The discussion of industry is very weak. While the discussion of agriculture is based on a reasonable model and the author's experience, that of industry is vitiated by a poor model, and a lack of knowledge of recent historical experience. For example, India's doubtful experience with cottage industry on the basis of policies similar to those advocated by the author is ignored. I seriously question the adoption of past Indian policies in this sector, which India has itself largely abandoned, as a model for other countries.

For all these reasons the book did not reach expectations. As a monograph

on agricultural growth that section has much to offer; as a more general study of economic growth, either in universal or Asian terms, it is weak.

GEORGE ROSEN

*Asian Development Bank*

*Money and American Society 1865-1880.* By WALTER T. K. NUGENT. New York: The Free Press; London: Collier-Macmillan Ltd., 1968. Pp. xv, 336. \$7.95.

Nugent's scope is much narrower than his title; his chief concern is the monetary status of silver. The coinage legislation of 1873, which discontinued the unrestricted coinage of silver dollars, is the focal point of attention. Important counterpoint is furnished by a review of the (largely abortive) campaign for international agreement on monetary standards and units. The book presents a social-political narrative complementary to Irwin Unger's masterful study of *The Greenback Era*. It is a modest but useful addition to the literature.

The Coinage Act of 1873 received relatively little attention when adopted, since at the time specie payments were still suspended. The coming of an economic depression and the coincident drastic fall in the value of silver, however, brought the measure into prominence, and it was denounced as the "Crime of '73." It would be an interesting exercise in counterfactual history to explore the probable results, had the silver dollar not been dropped, but Nugent does not explore this question very far. His brief sketch of probable economic consequences is not very persuasive, and his discussion of arbitrage mechanics (pp. 99-100) is simply incorrect.

Nugent argues that the architects of the Coinage Act of 1873, chiefly John Sherman and William Linderman of the Mint, had for several years foreseen the likelihood that increased production of silver would lower its market value, and worked to head off, by demonetizing silver, expected harmful consequences to the economy and to the public credit.

The narrative begins with an interesting review of the International Monetary Conference at Paris in 1867, full of enthusiasm for international monetary unification on a gold basis. Sherman, who attended the conference, introduced a bill for that purpose in the Senate in January, 1868, and measures of the sort were continually in the mill thereafter. Little overt opposition to the demonetization of silver appeared. The motive of demonetizing silver was not extensively debated, but Boutwell's Finance Report of 1872 made the case very explicit. Subsequent arguments that the 1873 bill was sneaked past an unsuspecting Congress cannot be upheld.

The panic of 1873 and subsequent depression made silver a major controversial issue. Nugent shows the important difference between the relatively conservative advocates of international bimetallism and advocates of "free silver," the more radical domestic expansionists. Although the case for silver received a sympathetic treatment from the United States Monetary Commission in 1877, the hopes for international bimetallism were disappointed. All the trends in Europe (well detailed by Nugent) were running in the contrary

direction, as demonstrated by the abortive International Monetary Conference in Paris in 1878.

Nugent discusses the relation of coinage policy to policies involving the national debt, the greenbacks, and the national banks, but adds little to our knowledge. The economic significance of coinage policy is not very adequately developed. Nugent is not an economist, and he has structured the issues very much as contemporaries structured them. One may fault him more for not digging into some technical details of administration. He assumes at several points that individuals could exchange one precious metal for the other at the Mints at the mint ratio, an arrangement which would facilitate arbitrage. However, Mint statutes simply provided that each person would receive back the same metal he deposited. And if Nugent's assumption were correct, there would have been arbitrage in the other direction prior to 1873, since silver was at a premium relative to gold. The international significance of coinage policy is not analyzed; Nugent believes that "If people, including Americans, bought British goods or services, they paid in gold" (p. 8).

Nugent devotes much attention to the impact of the depression of the 1870s on public opinion. Commendably he follows modern scholarship in the opinion that output did not decline; unfortunately this leaves him with no convincing reason why the depression hurt anyone. Some reference to the strong impact on the distribution of real income and wealth, the increased burden of debts, and industrial unemployment (particularly in 1877-78) would have strengthened the political narrative.

At some points, even the political narrative needs more detail. When Sherman's coinage bill first passed the Senate in 1871, he voted against the final version, presumably objecting to provisions for coinage charges by the Mint. Nugent refers to this only casually, yet it seems to require fuller discussion. Did Sherman believe the coinage charge was more important than demonetizing silver? Or did he vote against the bill only because he was certain it would pass?

Nugent's concluding section is one the economist can endorse heartily. He feels that the protracted dispute over silver was a sterile political dead end, replete with misplaced moralizing and group distrust, which distracted people away from real solutions to their economic problems. The reluctance to look upon money in a functional sense has continued to trouble American economic policy to the present day.

PAUL B. TRESPOTT

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### Statistical Methods; Econometrics; Social Accounting

*The Wharton Index of Capacity Utilization.* By LAWRENCE R. KLEIN AND ROBERT SUMMERS. Philadelphia: Economic Research Unit, Wharton School of Finance, University of Pennsylvania, 1966. Pp. vii, 94.

More and more frequently, time-series with the label "capacity utilization" appear in empirical production functions, investment demand equations, price

mark-up equations, and other relationships describing business behavior. In spite of the common label, utilization series differ widely in underlying concept and in basic data sources. It is the purpose of the present volume to make perfectly clear for one widely used set of utilization measures—the Wharton School indexes—exactly how the final numbers are derived from basic sources, and leave, as the authors put it, “statistical tracks so that other investigators may duplicate or extend the relevant series.”

As a statistical reference work, the result is exemplary. Each critical decision is set forth clearly, and charts and tables show estimated output and capacity indexes for each of the 36 component industries. Aggregate utilization indexes based on three different sets of weights appear, and there is a section comparing aggregate utilization with two measures of the “GNP gap.” Readers are made well aware of the many possible sources of error in the estimates.

The Wharton indexes make use of two basic techniques of capacity measurement, physical quantity measures based on government and trade association data, and the so-called “trend-through-peaks” method. Physical capacity and output data are used for four service industries, in the first attempt to measure quarterly utilization outside the industrial sector, and for crude oil. The basic assumption of the trend-through-peaks method, which is used to estimate capacity in all the remaining industries, is that output reaches the same per cent of capacity at each output peak; output peaks then serve as benchmarks for the capacity series, which is filled in between peaks by means of linear interpolation. One problem with the method is, of course, that some peaks may represent lower utilization than others. The authors, well aware of this danger, have adjusted the capacity estimates by omitting selected “weak peaks” from the calculations in eight industries on the basis of estimates from production function studies. Production function data were available for only thirteen industries, however, and there has been no adjustment of capacity for any of the other industries. A second problem with the trend-through-peaks method is extrapolation beyond the most recent peak; since there is no benchmark to guide the extrapolation, utilization estimates on a current basis are especially subject to error.

The GNP gap comparisons raise a small technical puzzle. The authors assume that for a fraction,  $m$ , of the total economy, utilization is measured by the quantity,  $U/U_{\max}$ , based on their indexes, and that for the remainder of the economy (covering finance, trade, government and agriculture), utilization is always at one (that is, 100 per cent). Under these assumptions, one simple way to calculate aggregate utilization is  $(U/U_{\max})m + (1-m)$ . The GNP gap, or one minus utilization, is then  $(1-U/U_{\max})m$ . The authors (p. 88) use a more complicated formula whose rationale is not clear to this reviewer. Given their formula, estimates of the GNP gap are very similar in level and amplitude to those of the Council of Economic Advisers and to estimates based on “Okun’s law,” except that the latter tend to lag the others slightly.

At a broader level an important and unsolved problem has to do with the concept of capacity the authors attempt to measure. As they make clear,

they wish to measure "potential output" in the sense of output associated with full utilization of *all* factors of production. The usual concept, related to short-run cost curves in the theory of the firm, has to do with fixed capital alone—capacity is defined as most efficient level of operation of the existing capital stock, or the point at which it becomes prohibitively expensive to produce any more with the given stock. If there is a change in the civilian labor force, Klein-Summers capacity changes instantly, but capacity according to the usual concept doesn't change, at least until the labor force change affects relative factor costs. The theoretical relation of the Klein-Summers concept to the demand for capital goods and price mark-up behavior remains to be explored.

My guess is that definitive measures of utilization, if we ever get them, will differ in both concept and technique from the present Wharton indexes (Klein and Summers might well agree). At the conceptual level, one highly promising development is the natural interpretation of capacity in so-called "putty-clay" models of production. Charles Bischoff and Peter Tinsley have both recently constructed experimental capacity measures based on putty-clay models. At the statistical level, careful use of capital expenditure data and use of survey questions about current rates of operation (both of which the Wharton indexes disregard entirely, in contrast to other available utilization measures) seem to offer much promise. Until definitive indexes come along, however, the present Wharton measures are quite useful, and the detailed exposition of their construction in the present volume sets a standard which future workers should strive to maintain.

FRANK DE LEEUW

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### **Economic Systems; Planning and Reform; Cooperation**

*Planning Reforms in the Soviet Union, 1962–1966.* By EUGENE ZALESKI.

Translated by MARIE-CHRISTINE MACANDREW AND G. WARREN NUTTER. Chapel Hill: University of North Carolina Press. Pp. viii, 203. \$6.00.

This book distills a great deal of solid reading in the Soviet literature. As a specialist in the field I have benefited greatly, and much admire the industry and patience which have sustained Zaleski through so much work. He has written an ideal handbook on the subject of his title for his Sovietological colleagues. But I doubt if the nonspecialist will benefit so much. For, doubtless without a detailed intellectual framework of his own whereby he may order and understand the myriad conflicting Soviet voices, he is not offered one by the author either, and parts of the book become a mere heap of data. Thus there is lack of interest not merely in Marxian but also in Western theory (pp. 81, 82–83). In particular the theoretically possible alternative planning and market structures are nowhere set out in a systematic way.



There is, deliberately, little on pricing principles (a surprisingly tolerable omission, which contributes much to the readable length of the whole), or agriculture (a wise neglect, since its whole organization is different). It is much more regrettable that the planning hierarchy should be presented without the political intrigues that shape it. For the multiple changes cannot otherwise be understood. Just for instance, very few people at all will remember the difference between the USSR Sovnarkhoz (founded November 1962) and the Supreme Sovnarkhoz (founded March 1963). It is much preferable to refer to them as the Dymshits Sovnarkhoz and the Ustinov Sovnarkhoz. Dymshits was Khrushchev's protégé and had come up through various appointments in the construction field. Ustinov and his Sovnarkhoz were installed over Khrushchev's opposition, at a moment when he was weak. It does not, therefore, "come as a surprise" (p. 37) that Ustinov is an armaments expert: on the contrary this is our main clue to the understanding of the whole imbroglio. As the admirable chart on page 22 shows, Ustinov had under him—while he lasted—the whole armaments industry. The "Ustinov" State Committees (e.g., for medium machine-building, which is a cover-name for atomic power) were really production ministries, while the civilian "Dymshits" State Committees were functional and advisory bodies as their name implied. The "line" command over civilian industry ran via the regional, lower-level, Sovnarkhozes, from which the armaments industry was effectually subtracted.

But if we miss the political essence, we do get the administrative formalities in full. The charts are exceedingly valuable, and alone justify the purchase of the book. Equally good are the passages (pp. 94–113, 155–56) on wholesale distribution. It is now well established, though the author does not say so firmly enough, that reforms here are the core of all genuine planning reform, as opposed to mere tinkering with the administrative hierarchy. Even such moderate reforms as those of Liberman, who merely wanted free enterprise choice of inputs, while outputs were still to be centrally planned, shatter upon the rock of planned materials allocation. There is of course a logical error in Liberman, in that each enterprise's inputs are another enterprise's outputs; but even if we overlook this, how can anyone choose his inputs freely if a whole tremendous bureaucracy still controls the allocation of materials? So long as this parallel, and uncoordinated, bureaucracy survives, decentralization means only that the director has increased control over labor (which is on a free market, and so not seriously allocated by anyone). It follows that Soviet—and even Czechoslovak—decentralization has interesting "anti-proletarian" overtones. It is a great pity that neither these overtones nor (almost) any labor question are discussed at all.

The last chapter, however, is excellent, though rather too anti-Soviet for my personal taste. The fundamental social, as opposed to political, obstacles to reform are indeed very great. But with the examples of Czechoslovakia, Hungary, and even Bulgaria before us it is difficult to be blankly pessimistic about the future of decentralization, rationality, and the market in USSR. Moreover Zaleski takes far too gloomy a view about the actual output performance of the present system. This barely expressed premise underlies too

much of his, seemingly unconnected, opinions on other subjects. Nevertheless I cannot close without a strong positive recommendation: this is the best book yet on that millennially important subject, the Soviet reforms in industrial planning. It contains more sheer, solid information than any rival.

PETER WILES

*London School of Economics*

*Mathematical Planning of Structural Decisions.* By JANOS KORNAI. Amsterdam: North-Holland Publishing Co., 1967. Pp. xxvi, 526. \$18.20.

This book is a landmark in the history of planning and the application of mathematical techniques in socialist countries. It describes the evolution of the author's use of programming methods in planning the Hungarian economy. Many previous attempts to apply mathematical methods in socialist planning either stopped short with a very partial solution—e.g., the location of creameries in Moldavia—or began as grandiose schemes to make an optimal plan for the whole economy and ended with no practical result. Kornai has had the genius to build from a very specific and practical beginning yet work toward an ever more comprehensive planning system.

He identified the choice of investment projects as the key to useful central planning and began with an analysis of the alternatives open to the cotton textile industry. The industry had to meet its assigned output quotas while living within its investment, construction, and foreign exchange quotas. Its alternative activities included buying new machines of various qualities, improving old machines, building new plants to house the new machines, or scrapping old machines to make room for new machines in old buildings. By scrapping a lot of old machinery and replacing it with new in the same space, and by holding down on construction and capital repair, the mathematical solution cut costs by 15 per cent relative to the official proposal. The official plan was revised along the lines indicated by the model.

This application proved so successful that by 1965 when the book was published in Hungary, more than 40 similar industry studies had been started. But Kornai knew their limitations: the uncertainty about the data, the distortions of the price system, and the non optimum character of quotas within which the industry studies were done. These problems occupy the last three parts of the book.

Uncertainty was handled by establishing the tradeoff between expected returns and their variances. It seemed to me a pity that no use was made of the measurable-utility approach to decisions under uncertainty.

To circumvent the distortions in the official prices, computational prices were constructed by use of input-output tables. These prices are based upon a uniform rate of return on capital, chosen equal to the rate of growth, and upon calculated exchange rates based on the assumption that imports must be paid for with exports having the present proportions among the commodities. The computed prices differed from actual prices by more than ten per cent in 52 out of 80 industries.

Finally, Kornai seeks a way to integrate many industry studies into an

overall optimum plan. This portion of the book is likely to prove more valuable for its discussion of the optimality criterion than for the two-stage algorithm which it proposes. This algorithm is sort of a dual to the Dantzig-Wolfe decomposition method (though not a true dual). In the decomposition method, the planning center announces prices and the subordinate units reply with proposals of quantities bought and sold. In the Kornai method, the center announces the quantities each subordinate is to buy and sell, and the subordinates reply with prices indicating how much inputs are worth to them. This system matches the planning practice of socialist countries much better than does the decomposition principle. Unfortunately, no computationally efficient way has been found to use the prices proposed by the subordinates to reallocate resources among them. (Perhaps having the subordinates give two points rather than one point on their demand curve would help.) The way used by Kornai converges to the optimum; but the convergence is slow, as he plainly points out.

One cannot read a work of such sweep and solid accomplishment without being tremendously impressed. Fortunately, Kornai writes with such clarity that it is a pleasure to read. The book should certainly find a place on the reading lists of most courses dealing either with comparative systems, socialist economies, or applied quantitative methods. Unfortunately, in his pricing decision, the publisher underrated the size of the potential market. The difference between his \$18.20 and the price of the Hungarian version, about \$1.20, leaves no doubt that somebody's price system is distorted.

CLOPPER ALMON

*University of Maryland*

*Mathematics and Computers in Soviet Economic Planning.* Edited by JOHN P. HARDT, MARVIN HOFFENBERG, NORMAN KAPLAN, AND HERBERT S. LEVINE. New Haven and London: Yale University Press, 1967. Pp. xxii, 298. \$7.50.

The use of mathematical methods in Soviet economic analysis, management and planning—once condemned by Stalin as a mere “game with figures”—is increasingly gaining acceptance among the Soviet Union's economists, managers, planners, and even top policy makers. Since the mid-1950s, an intensive period of familiarization with Western advances in cybernetics, scientific management, and econometrics has opened up in the USSR, and more or less formal linkages have been established between Western methods and traditional Soviet approaches to economic theory and planning. Since the mid-1960s conditions have been created for the application of some of these methods to special management and planning problems and also for the charting of new paths in the exploration of cybernetics, macroeconomic dynamics and kinetics and optimization theory. The more or less organic connection between the traditional Soviet approaches to economics and planning and modern econometrics was achieved by the late V. S. Nemchinov and by some other older generation economists and mathematicians like V. V. Novozhilov and L. V. Kantorovich. Some of the key contributions of this first

period of readaptation of mathematics to economics were included in a volume edited by V. S. Nemchinov in 1959, *The Use of Mathematics in Economics* (published in an English translation in 1964). As both older and younger economists and econometricians attempted to make their own mark on "planometrics," a number of interesting and significant Soviet (and East European) studies have been produced, not only on programming problems but also on the theory and management of systems, and on optimality questions.

The present volume surveys, analyzes, and evaluates the Soviet work in these fields during roughly the first decade of the "reintroduction" of mathematical methods in Soviet planning, 1956-65. It contains four major papers and comments presented at a conference held at the University of Rochester in May 1965. The competent opening study of Richard W. Judy (followed by the stimulating comments of Robert W. Campbell and Robert Summers) describes the traditional Soviet planning and information system, with its weaknesses and limitations and the new Soviet research on the creation of a nation-wide modern economic information system with computer "hardware" and appropriate programming language. Two highly informative papers by Vladimir G. Treml and Benjamin Ward (followed by comments by Abraham S. Becker and Michio Hatanaka) survey the history and state of Soviet efforts in input-output and linear programming and the specific attempts made there for the application of "operations research" at the industry or enterprise level. Finally, a study by John M. Montias (followed by comments by Edward Ames and Clopper Almon) discusses Soviet optimizing models for multiperiod planning. A comprehensive introduction by Herbert S. Levine places the discussions and their results in perspective. He stresses notably that the Soviet work in the use of mathematical methods in economics has thus far been "primarily derivative and not outstanding" and that the elapsed time since the beginning of this Soviet "revolution" has perhaps been too short for drawing a definitive balance sheet on its impact on planning and management practice.

Since the time of the conference, the Soviet (and East European) economists and mathematicians have made persistent and interesting efforts to enlarge the debate particularly concerning system modeling and redesigning. Cybernetics, the new science of communication and control, has been used for uncovering connections between "steering mechanisms" (by management and planning) and their targeted economic "subsystems" and activities. A number of Soviet writers (A. I. Katsenelinboigen, Iu. N. Gavrillets, E. Z. Maiminas, V. A. Volkhov, Iu. R. Leibkind, A. L. Vainshtein, K. L. Gorfan, V. A. Volkonskii, to mention but a few) have concentrated on the study of: (a) the connections between types of organizational structure, communication, steering, growth and uncertainty; and (b) the linkages between the overall system, its subsystems and the internal, operation research problems of the latter. Much has been done also along these lines in Eastern Europe. Unfortunately little of this could be surveyed as of the holding of the conference; Judy's paper is primarily focused on the information aspect, rather than on the broader model-redesigning question.

As Levine rightly notes in his (1967) Introduction, the Soviet input-output and linear programming "fronts" have stayed relatively quiet since the time of the conference. However, besides the input-output balance of 1959 (with its 83 sectors in value terms and 157 products in quantity terms) exhaustively examined by Trembl, Soviet work has been proceeding with the preparation of a balance for 1966 (for 110-115 sectors and 230-250 products) and of theoretical dynamic input-output models (viz. the works of V. S. Dadaian, M. R. Eidel'man, A. N. Efimov, etc.) Many of the inherent difficulties connected with the uses of the mathematical methods in planning and of the linkup of input-output with the traditional method of Soviet "balances" have been further clarified since then by the stimulating work of Janos Kornai, *Mathematical Planning of Structural Decisions*, published in Budapest in 1965 and made available in an English translation last year.

The Soviets are, however, giving only a relatively subordinate role to input-output analysis, as they try to concentrate on a so-called "national cybernetic program" advocated by V. Glushkov and N. Fedorenko. The key element of such a program is a dynamic national economic optimization model of continuous planning, but the theoretical work on this score is lagging, and the actual prospects for implementation are still remote (see Becker's comments).

In the general field of optimization, Montias has chosen to concentrate on two optimal long-term planning models of Kantorovich, a dynamic input-output and multilinear planning model of Mikhailovskii, and some aggregative growth sector models, notably those of Pugachev. This is clearly a long list; however, one may regret that Montias could not review even in passing a number of problems in which the Soviets are deeply immersed—viz., the determination of the optimal values of the "steered" parameters (in steering systems); optimal "norms" of accumulation; "optimal effectiveness" of investments and optimal capital formation (related to planning). Be that as it may, in no case—as rightly pointed out by Almon—have the Soviet authors come to grips with the crucial mathematical problem of such studies, namely, "how to determine the course of investment from the course of final demands."

The volume thus presents a highly stimulating and competent discussion, one which significantly advances our knowledge and understanding of Soviet planning and management theory and practice. A significant part of the literature on the general field of "mathematics and computers in Soviet planning" remains outside the compass of this work. But this could, of course, be the subject of another conference.

NICOLAS SPULBER

*Indiana University*

*Aims and Methods of Soviet Planning.* By MIKHAIL BOR. New York: International Publishers. London: Lawrence and Wishart, 1967. Pp. 225. \$6.95.

This book by a Russian economist describes and analyzes Soviet planning theory and techniques in the mid-1960s. It focuses on certain aspects of the

elaboration of the current Soviet Five Year Plan for 1966-70. In contrast to the usual Soviet books, preoccupied with the idea of showing how Soviet planning is supposed to operate, Bor attempts to show how this system actually works. He also makes a serious effort to compare Western programming with Soviet planning, in order to uncover what he believes to be the shortcomings of the former and the virtues of the latter.

Some interesting clues are given concerning the process of formulation of the preference function in Soviet planning. The decision sequence is more complex than is usually assumed. Certain elite groups do indeed possess the power to inject their preferences and evaluations into the system right from the outset. Elaboration of the "main trends of national economic development" for 1966-70, for example, was preceded by the issuance of broad governmental instructions to the USSR Academy of Science and its institutes, and to the state committees and ministries. The scientific establishment and the top managers of the economy were requested to determine the main trends of technological progress in different branches of industry in 1966-70. After they formulated their analyses and proposals and dispatched them to the State Planning Committee (Gosplan) the latter drew, on their basis and on the strength of its own evaluations of past economic achievements, a preliminary variant of the trends of the plan, of the major intersectoral relations, and of the income flows during the plan period. These documents were then submitted to the policy makers, and, after they had made their decisions, Gosplan prepared the control (target) figures for ministries, departments, and other supervisory agencies. So far as the consumer is concerned, the planners alone estimated how his "needs will grow in the future," no mechanism being available for injecting his preferences into the plan at that stage.

Planning techniques are currently a bizarre mixture of traditional methods and new mathematical methods imported from the West. The most important macro models used in planning are now a provisional input-output table of the economy, matrix models of sectoral plans and, finally, linear programming models for a special group of production and transportation problems. As in the past, however, final plan formulation and implementation depends on the establishment of "plan indices" and on the methodological instructions issued for their application. These indices or norms, elaborated by Gosplan, are technological coefficients relating inputs and outputs expressed in value or physical terms. They are meant to tie together the various parts of the plan as well as the entire plan structure. The only difference from the past is that previously the planners were concerned with the quantitative side of the indices and with the quantitative aspects of production, particularly of the industrial plan; now, as Bor stresses it, the new system of indices introduced in industry underlines the close interconnection between the volume of goods sold, the target for production of goods in physical terms, and the profit index. As in the past, the binding norms and instructions of Gosplan hold the entire planning structure together.

In contrast to this directive nature of Soviet planning and its centralized way of meeting the scheduled input requirements of enterprises, Bor finds Western programming (as practiced in France for instance) with its advisory

character and lack of special agencies for securing and checking plan fulfillment, largely ineffectual. However, Bor concedes that Western policy makers and programmers have at their disposal: (a) administrative means for influencing private enterprises through legislation; (b) systems of purposive state benefits (viz. subsidies, tax reliefs, etc.) for selecting and encouraging the direction of development of private enterprises; and (c) an important economic lever in the form of government purchases involving 30-45 per cent of the national income. The biggest shortcoming of Western programming is, according to Bor, the lack of a "direct organizational-economic tie between even the most elaborate national programmes and the programmes of individual enterprises." (pp. 225-26). "Is any effective planning of production possible," wonders Bor, "without specific targets? Without any obligation on the part of enterprises of meeting these targets? And finally, without any real possibility for enterprises to co-ordinate their operations?" (p. 223)

Thus, in essence, the lack of binding instructions is allegedly the main trouble of programming. But it is precisely on this matter that the past and the future clash in present-day Soviet planning theory and practice. Bor himself notes that the time has come to try to unfetter the initiative of the Soviet enterprise from the tutelage of supervisory agencies. Thus he wonders where the "limit of penetration of directive planning into the sphere of activity of an enterprise" should be drawn (p. 222). The Soviets have not yet found how to reconcile satisfactorily the key macrostructural decisions of the planners with the microinitiative and efficiency of the enterprise. They are probing timidly for the "limit of the extension of the independence of the enterprises"; they wonder, hesitate and search again, but they know that the question urgently awaits an answer, and that this answer will undoubtedly shake severely the system of "plan indices and methodological instructions" on which Soviet planning has confidently rested until now.

NICOLAS SPULBER

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*The Economics of a Socialist Enterprise—A Case Study of the Polish Firm.*

By GEORGE R. FEIWEL. New York: Frederick A. Praeger, 1965. Pp. 398. \$17.50.

In this book, a review of the socialist enterprise is made. The focus is mainly on the Polish firm. This work starts with an historical review of the Polish economy since World War II. The different central planning philosophies are commented on. The different plans themselves are then discussed, particularly with regard to their bearing on the socialist industrial enterprise. The pros and cons of more decentralized planning for Polish enterprise are put forward through the different opinions of the leading planners and economists of Poland. Thus, Brus, the true Marxist, advocates a strong centralization of planning for the enterprise, whereas, Kurowski advocates letting supply and demand play loosely and this would eventually cure all illnesses of the Polish economy through the resulting price adaptation. Lange

goes the middle path and advocates price planning but decentralized decision making for industry. Due to Lange's preference for linear programming, it is only fitting that he would solve the problems by overall imputed pricing.

The economic and sometimes the political aspects of the main issues are widely discussed in this book. The hot issues of a planned economy revolve mainly around one basic point, price; its formulation and its determination are generally the most crucial conceptual problems. It is very interesting in this respect to learn of the ideas of Fiszal, whom one can consider one of the main specialists of pricing in Poland. He is not in favor of Lange's trial and error manner of pricing at the plan level; shadow prices for the plant seem to him and his followers much more convenient. Again, this implies the use of what we know in the West as linear programming.

It is remarkable that the Poles themselves have already discovered that low material costs will induce low efficiency and, therefore, also low wages. On the other side, the low price of capital assets will not enhance technological advance.

The problem area of managerial skills and personal inducement, which is seen as one of the more critical aspects of the socialistic enterprise at this moment, is dealt with in the last chapter of the book.

We can only hope that there will be a few more Praeger International Studies with this kind of research in depth, detail, and thoroughness. The ample bibliography at the end of the book and the many references to original sources are very helpful to guide the intellectual explorer deeper into the problems of planning if he so desires.

J. M. VENTURA

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### Business Fluctuations

*The Goal of Full Employment.* By ROBERT AARON GORDON. New York, London, and Sydney: John Wiley and Sons, 1967. Pp. ix, 204. \$6.95.

Those of us who were brought up on Professor Gordon's classic text on business cycles have come to expect his treatment of problems in macroeconomics to contain a skillful blending of theory and empirical materials, tempered with excellent judgment on the crux of the matter under consideration. In the present volume, these expectations are more than fulfilled. In this book, which is merely a part of the output of a research program on Unemployment and the American Economy being carried on at the Institute of Industrial Relations at Berkeley, Gordon tackles several very important problems and gives a masterful performance.

Within the space limitations of this review, only a brief summary of the key conclusions of the work can be given. The very short introductory chapter raises the important question of why the United States has done so poorly with regard to its high employment goal, both absolutely and in comparison to the European countries. Chapters 2 and 3 are an articulate discussion of



the aggregative goals of public policy. While no summary can convey the skillful manner in which the author arrives at his conclusions, some of the more important conclusions may be stated. Priorities attached to these goals do vary over time, among countries, and among groups within a country at one point in time. The European countries tend to give a much higher priority to the goal of full employment (see page 51, where a rough quantification of the full employment goal for four European countries is presented), and this is a large part of the answer to the question raised earlier. In the United States, the success of the 1964 tax cut has recently increased the priority given to the goal of high employment and reduced the priorities for the goals of stable prices and of maintaining (or achieving) a satisfactory position with regard to the balance of payments. Unemployment itself is partitioned into three categories: frictional unemployment, unemployment due to deficient aggregate demand, and structural unemployment; this partitioning is important because different sets of policies (or at least a different emphasis) may be required even at a given total amount of unemployment when the composition varies. Finally, the problems of disguised unemployment and involuntary part-time unemployment do not prevent us from measuring our aggregative employment goal in terms of the conventional statistics on the unemployment rate. These phenomena do suggest, however, that a higher priority be given to the high employment (and hence lower priorities to competing or conflicting goals) than one would give in the absence of these phenomena.

In Chapter 4, Gordon suggests a novel definition of full employment. The notion of a trade-off or "Phillips" curve between the rate of unemployment and the rate of change of prices is accepted as a (perhaps temporary) constraint on monetary and fiscal policy. Indifference curves connecting these two variables are posited, on the assumption that there is always some marginal rate of substitution at which one is willing to trade fuller achievement of one goal at the expense of a unit shortfall in the achievement of the other goal. The full employment point is then taken to be the rate of unemployment which, in this way of looking at the matter, maximizes social welfare. This is a formulation which is very congenial to the present reviewer.<sup>1</sup> Gordon points out that this definition of full employment need not coincide with the "Beveridge point" (equality of job vacancies and individuals out of work). It is almost true that goals with regard to the pattern of unemployment will interact with the aggregative goal, under this definition. Thus, if manpower policies succeed in shifting the tradeoff curve leftward, the position of full employment would, on this definition, correspond to a lower rate of unemployment (assuming unchanged indifference curves on the part of the policy maker). These points are taken up in greater detail in the final chapter.

Chapters 5 and 6 are devoted to a statistical examination of the issue of

<sup>1</sup> In *Price Stability and High Employment: The Options for Canadian Economic Policy*, Ottawa 1967, a group of us (Ronald G. Bodkin, Elizabeth P. Bond, Grant L. Reuber, and T. Russell Robinson) independently put forward a very similar type of analysis. Our interpretation of the tangency point was that it gave the "optimal" rates of inflation and of unemployment.

structural unemployment. Gordon is willing to concede that there has always been some structural unemployment; the key question is whether it has worsened significantly over the past decade. The bulk of the prose of these two chapters is devoted to the numbers themselves, which some will find fairly tedious reading; nevertheless, at times the numbers themselves cry out with their own story, as one reads of Great Depression rates of unemployment among nonwhite teenagers—22.6 per cent for boys and 29.8 per cent for girls, in 1965! Gordon's principal conclusion is that any increase in structural unemployment that has occurred during the past decade has come from the supply side (largely, a large influx of young and generally not well educated workers) rather than from the demand side (rapid technical change in some industries and/or occupational or regional shifts in the composition of demand). In turn, it is argued that the various forms of job security practices and the tendency to reduce the labor force of declining industries and regions by natural attrition place a disproportionate part of the burden of inadequate aggregate demand on the inexperienced young workers who have never held a permanent job. In addition, these same kinds of factors appear to have made it difficult for married women to enter (or re-enter) the labor force.

In a very pregnant final chapter ("Toward Full Employment"), Gordon sets out some suggested goals for the pattern of unemployment rates; specific target unemployment rates are proposed for a breakdown of the labor force by age-sex categories, by race-sex categories, and by occupation. Not everyone will agree with the pattern proposed; an uncompromising idealist would argue that the target unemployment rate for Nonwhites should be no higher than that for Whites, instead of  $1\frac{1}{3}$  times as high, which is the ratio implied by Gordon's specific target rates. (In 1965, the Nonwhite rate of unemployment was roughly double that for Whites.) But Gordon's approach strikes the reviewer as a feasible one, one that has some chance of actually being achieved in the near future. It is interesting to note that the targets for the specific unemployment rates (regardless of which of the three breakdowns are employed) always imply an aggregative unemployment rate of approximately 3 per cent, a rate that some of us have regarded (on the basis of historical experience) as being a closer approximation to full utilization of the labor force. The balance of the pages of this chapter (and the appendix as well) is devoted to a re-examination of the aggregative goal of a 3 per cent unemployment rate, in the light of the contribution that manpower policy can make to mitigating the conflict between the high employment and price stability goals. It is interesting to note that Gordon feels that some version of an incomes policy (wage-price guideposts or the like) can play a minor role (but one that is definitely secondary to manpower policy) in this effort. Gordon ends his text by frankly admitting that we cannot be sure of the outcome (largely because such an effort has never been tried before), but that the rewards are so high that the effort is well worth making.

In the conventional wisdom, a balanced review should point up weaknesses as well as strengths. It is very difficult to do this with Gordon's book; nevertheless, the reviewer should perhaps indicate to the reader the way in which

the author has fallen short (but only barely) of perfection. First, the reviewer raised an eyebrow in Chapter 2 when "incomes policy" was termed a "goal"; he had always thought of it as instrument. (But Gordon later lists it as a constraint rather than a primary goal, and when later on he calls it a second-order constraint, the difference between us is clearly approaching a semantical quibble.) Secondly, Gordon argues that his measure of relative dispersion of specific unemployment rates,  $D_u$ , is useful for studying changes in structural unemployment only during periods of adequate aggregate demand; a reasonable case can be made for this position. He then goes on to argue (on page 113) that one should probably standardize this measure for the variation in the aggregate unemployment rate even during "full employment" periods. But if this is done, why not simply use the absolute dispersion measure, restricting this measure to "full employment" periods? Thirdly, the analysis of the problem of the structure of unemployment rates by color seems rather mechanically confined to the statistics themselves, in contrast to the brilliant analysis of the other aspects of the structural problem. (It is true that there is less to explain in terms of movements of the dispersion index, but the absolute gap between White and Nonwhite unemployment rates does seem to require some type of explanation. It is also true that some very tentative hypotheses regarding this gap are put forward in a couple of footnotes, but these explanations remain largely undeveloped and unintegrated with the major discussions of the text.) Finally, the index is substandard; it is to be hoped that later printings of this excellent volume will have a more adequate one.

In summary, this is an excellent book. For those working in the field, it is mandatory reading. For any other economist who wishes to read just one book outside his area of primary interest, this book should be his choice. And large portions of Gordon's book could be profitably read by noneconomists as well.

RONALD G. BODKIN

*The University of Western Ontario*

*The Economics of Cycles and Growth.* By STANLEY BOBER. New York: John Wiley & Sons, 1968. Pp. x, 305. \$8.95.

If one feels that there is a need in the economics curriculum for a specific course in business cycles this text is quite well suited to the task. Mr. Bober has diligently gone through the literature on business cycles and has to a large extent synthesized the essence of that literature into a fairly well-balanced book. The tools and techniques of analysis—principally difference equations—are developed and explained prior to being used. Adequate coverage is given to the data of the business cycle. Most of the historically important models of the business cycle, from Samuelson through Kaldor, are explained thoroughly and concisely. However, there are some major shortcomings.

At no time was I able to find any mention whatsoever of money, a fractional reserve banking system, or monetary policy. This omission, however, was typical of the business cycle literature of the late 'thirties, 'forties, and early 'fifties. Monetary explanations or even partial explanations were com-

pletely out of vogue during that period. Mr. Bober did not make any attempt to include some of the more recent causal models involving money. Along the same line there is no mention of portfolio balance models or even how portfolio balance considerations would modify—if at all—some of the models discussed at length.

The other very important omission, which appears to have been deliberate [preface vii], is any discussion of monetary and fiscal policies and attempts to stabilize business fluctuations. With the ever-increasing importance of the government sector and the apparent realization in the post-Eisenhower era of the potential stabilizing effects of government receipts and expenditures, this is a major omission, indeed. Not only are stabilization measures important from a policy point of view, but discussion of them is an excellent teaching device. As many recent articles show, different forms of lags and leads have very different effects on national income, employment and prices over time. An understanding of the underlying mechanism of the business cycle is not sufficient; one must also have some understanding of the tools at hand. Needless to say, I do not believe that money and stabilization policies should be the core of a business cycles course, but surely they are important enough to discuss. These omissions are, fortunately, easily rectified by supplementary readings.

Even if one does not feel that business cycles should constitute a separate course in the economics curriculum, this text may still prove to be quite useful. A skimming of Chapters 4 and 5 along with a careful reading of Chapter 6 should be sufficient to give a student a good overview of the business cycles literature. In spite of the title of this book, the surface of the subject matter of economic growth is barely scratched.

ARTHUR B. LAFFER

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### **Money, Credit, and Banking; Monetary Policy; Consumer Finance; Mortgage Credit**

*Denar in kredit v narodnem gospodarstvu* (Money and Credit in the National Economy). By JOŽE POKORN. Ljubljana: Cankarjeva Založba, 1967. Pp. 520. 52.00 ND.

From the standpoint of Western assessment of the state of economics in Yugoslavia, the book under review is revealing on two accounts: first, because of the author's intimacy with modern currents in "bourgeois" economics and his uninhibited approach in discussing them; second, because of his admission that a body of monetary theory applicable to socialist economies does not exist, and hence his own attempt at supplying building blocks for such a theory. It would seem that this type of attitude is gaining ground among leading Eastern European economists and—*mutatis mutandis*—their Western colleagues striving to explain the socialist reality, whether their fields be the theory of the firm or macroeconomics.

Pokorn's survey of monetary and income theory as developed by Keynes, Hicks, and subsequent authors, which occupies one-fifth of the book, is likely to enlighten many a Yugoslav student of economics steeped in Marxian tradition, but it is obvious that some Keynesian notions central to modern analysis of capitalism are inapplicable to socialist economies. The speculative demand for money is a case in point. Even if in one of its metamorphoses the Yugoslav or any other socialist system should come up with a capital market, it is unreasonable to expect that the shifting of assets between cash and bonds or other nonmoney assets would occupy the place which it holds in capitalist economies.

It must be considerations such as these which have influenced Professor Pokorn in concentrating his attention on the purchasing power of money and in using the income rather than the cash-balances approach in this process. The former, which focuses on the mechanisms by which any change in the quantity of money becomes operative, rather than on liquid balances, has been pioneered by Aftalion, who expressed the purchasing power of money,  $1/P$ , as output over income,  $O/Y$ . But while Aftalion's equation shows only the aggregate supply ( $O$ ) and the aggregate demand ( $Y$ ), Pokorn separates in Keynesian fashion the supply of consumers' goods from that of investment goods and disaggregates wage-income according to various sectors (consumers' and producers' goods industries, government), taking into account personal savings and direct taxes.

Pokorn finds that ideas contained in Keynes' *Treatise on Money* are more profitable for a socialist theory of money than those of the *General Theory*. Like Keynes in his "fundamental equations," Pokorn distinguishes between the price level of consumers' goods ( $P_c$ ) and the price level of output as a whole ( $P$ ). However, while Keynes in obtaining his formula for the latter assumes the price level of new investment goods as given, Pokorn finds it apparently unnecessary to make such a provision. This is explainable precisely because for Keynes the determination of the price level of investment goods hinges on the scale of preference for savings-deposits and other securities at different price-levels of the latter, which is of little significance when dealing with socialist economies. Thus, for Pokorn's purposes, the Keynesian thesis according to which prices of consumers' goods alone measure the purchasing power of money (*A Treatise on Money*, Vol. I, p. 54) suffices. In the abbreviated version his equations for the purchasing power of money are as follows:

$$(1) \quad \begin{array}{ccc} 1 & R_k & \\ P_c & NW - S - T & \end{array}$$

$$(2) \quad \frac{1}{P} = \frac{0}{u(NW - S - T)}$$

where  $R_k$  stands for that part of the national product which is sold to households,  $NW$  for the money income of labor,  $S$  is savings of wage earners (less the consumption of capitalists under capitalism), and  $T$  is the balance

between direct taxes and government transfer payments. Replacing  $R_1$  by the entire output ( $O$ )—in the second equation—necessitates the introduction of  $u$ , which Pokorn calls the price multiplier. This factor  $u$  is the reciprocal of the average propensity to consume.

Introduction of foreign trade into the equations leads to the conclusion that exports and imports of consumers' goods alone affect the purchasing power of money, while exports and imports of investment goods are found to be neutral in this respect.

Pokorn's equations are not more and not less of an identity than either the Newcomb-Fisher equation of exchange or the Cambridge equation. Nevertheless, they show how in a state of equilibrium the purchasing power of money depends on the way in which investment and government expenditures are financed, that is, out of workers' savings and direct taxes, or out of an addition to the cost of consumers' goods. Needless to say, in their present form the equations fail to take into account dynamic effects of changes in such magnitudes as investment.

As an illustration of the applicability of his theory to Soviet-type economies Pokorn shows that money income and consumers' expenditure balances used in Soviet planning actually correspond to his first equation. In an empirical attempt of his own he then shows the "structure of the macroeconomic 'normal' price" based on Yugoslav data.

Pokorn's work offers a new look at the age-old problem of the value of money. Although the distribution of social product between wages and surplus value is central to his theory, it is as far removed from Marx's view of money as a commodity, as microeconomics in recent Yugoslav literature<sup>1</sup> is from the law of value.

TOUSSAINT HOČEVAR

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### Public Finance; Fiscal Policy

*Public Finance in Democratic Process.* By JAMES M. BUCHANAN. Chapel Hill; University of North Carolina Press, 1967. Pp. x, 307. \$7.75.

The greater part of this study consists of an attempt to indicate how the structure of a tax system influences the community's decisions with respect to pattern and level of government services. The voter-taxpayer-beneficiary and his representatives are viewed, realistically enough, as being faced with a specified fiscal system, imposed as it were exogenously. In the last one-third of the book the viewpoint is shifted, and the fiscal system is itself selected by those who are to live under it. In both cases the study formulates the considerations that should guide a rational voter-taxpayer-beneficiary in his own self-interest, whether he is voting on an increment to a government service under a given tax structure or whether, on the higher level, he is deciding what pattern of fiscal instruments he elects to live with.

These are important questions, not hitherto posed, or at least not posed

<sup>1</sup> Cf. Aleksander Bajt, *Uvod v politično ekonomijo*. Ljubljana: Cankarjeva Založba, 1965.

with the clarity and vigor that Professor Buchanan supplies. The answers seem to fall into two groups: those that are stimulating exercises of logic, revealing implications not apparent in the premises, and those that are somewhat thin, or unimportant, or that at least appear to be rather self-evident.

The former, more rewarding answers, deal with somewhat special cases, e.g., a choice between a proportional and a highly progressive income tax of equal present value by an individual with rising income, who is assumed to be able to lend but not to borrow at the government's borrowing rate. Buchanan shows that "rational choice will dictate that he 'vote for' meeting his obligation through the progressive income tax, provided only that his planned or preferred stream of private spending is more uniform than that of anticipated income receipts" (p. 229). While this deduction may possess little explanatory value alongside two world wars and a great depression, with their evocation of relative sacrifices and redistribution of disposable income, it throws further technical light on the elements of choice.

An example of the second, less fruitful type of answer, is that which points out that when the individual is appraising a proposed increment in government service, the more ignorant or uncertain he is of his true tax liability, the more likely he is to favor or oppose the increment of service, depending in part on whether he tends to understate or overstate his liability.

On occasion, one may question whether there is really a problem to solve. Buchanan concludes that, since the market behavior of other taxpayers under the specified tax will influence the aggregate value of the tax base, and hence will in part determine the tax rate ultimately necessary to raise the stipulated revenue, the taxpayer in question is faced with the need to predict that behavior before he can truly estimate the cost to himself of the proposed increment of service. In practice, however, most governments, in setting the tax rate, will try to take into account the reactions of all taxpayers to the tax, and the problem exists only to the extent that the government is unable to do this accurately. It is not evident why a presumption to the contrary need be made (pp. 45-46).

In one instance Buchanan's analysis lends support to a familiar conclusion, namely, that an old tax is less painful than a new tax, but here the traditional emphasis may be misleading. When consideration is given to a new tax (or a new increment to an old tax), to finance a proposed increment of service, taxpayers are commonly aroused to re-examine the entire tax system. The proposal not long ago to introduce an income tax in New York City was agreed to only on the condition (among others) that the gross receipts tax be repealed.

The most rewarding chapters in Part I are those on earmarking (Ch. 6) and on indivisibility (Ch. 9). Buchanan derives the conditions under which total expenditure will be greater, and those under which it will be less, under general-fund financing than under earmarking, given rational action by those favoring and opposing the service, and he derives in an elegant analysis the sign and size of the difference between actual and imputed components of any one service under general-fund financing. The limitations of this kind of analysis are likewise evident: it must abstract from the role, if any, played by the taxpayer-recipient in setting the ratio in which the general-fund tax

dollar is divided among the several services. When this assumption is relaxed to the point of facing the taxpayer with uncertainty as to what that ratio shall be, the conclusion, though still yielding us new insight, becomes less persuasive. And the value of the analysis is further limited by its being cast in terms of a single individual's wants, thus abstracting from infra-marginal disputes, under both earmarking and general-fund financing.

In the chapter on individual choice in the face of indivisibility, the infra-marginal issue is faced directly: the true nature and the limitations of Wicksell's unanimity rule are clearly developed, and some prevailing confusions on preference revelation are resolved. The chapter on simple collective decision models draws some interesting conclusions based on the median voter.

A lengthy chapter on the fiscal illusion is useful chiefly as a summary of the Puviani analysis, but the attempt to extend that analysis to modern tax systems does not quite come off, partly because much of the Puviani analysis is itself rather insubstantial. Another reference type of chapter is one in which Buchanan summarizes conclusions reached in recent studies on degree of taxpayer consciousness and awareness, and types of attitude, and the factors influencing these states of mind. But as the author notes, these research studies vary widely "both in rigor and in relevance for this study," and the reader would have appreciated more appraisal of each one. The impression left by the rather flat summaries of these research efforts is not an inspiring one; it is difficult to have much confidence in the prediction that "with these [state-local] data researchers should be able, with the aid of sophisticated techniques, to isolate the effects of some of the most important institutional variables" (p. 207).

The insight and rigorous analysis in this volume warrant the attention of any reader who is prepared to accept, as a price for the good things he gets, the fact that some of the problems turn out to be fairly intractable to analysis at the level of abstraction employed.

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*Public Investment Criteria—Benefit-Cost-Analysis for Planned Economic Growth.* By STEPHEN A. MARGLIN. Cambridge: M.I.T. Press, 1967. Pp. 103. \$5.00.

This extended essay on the theory of benefit-cost analysis provides an excellent introduction to one of the increasing number of tools being developed to improve the management of the public sector. Benefit-cost studies began in the 1930s as a justification measure for federal water resources projects. Since then they have been extended to many fields and they have become an integral part of budget planning and analysis of the federal government. The issues to be resolved have broadened, but the major problems were already stressed in the traditional topics covered by Marglin.

The volume has two major sections: superstructure and specific criteria. The superstructure is distinguished by an extended treatment of an objective



function containing arguments beyond the traditional restriction to economic efficiency. In practice, the administrator's response to the multiplicity of objectives is to specify a set of targets or to attempt to persuade the decision-makers of the relative importance of different goals. Marglin demonstrates the role of "revealing" an objective function in the interplay between the revision of targets or constraints and the analysis of the costs of achieving the different objectives. I.e., so long as the ratio of marginal costs of achieving different objectives is not equal to the marginal rate of substitution in decision-makers' preferences for these objectives, a change in the choice of projects is called for. The normative economic theorems are simple, but these lessons have not been applied in practice and this section develops the operational thinking in a way which will be of great help to practitioners.

In the second section the specific criteria discussed are: benefits, costs, time and interest, budgetary constraints, risk and uncertainty, dynamics, secondary benefits, private alternatives and alternative costs, and pricing policy for public enterprise. All of these criteria are covered in 52 pages, with 22 of them devoted to time and interest. Despite the brevity, the issues are handled with authority and great clarity. The choice of a discount rate is developed more extensively than any of the other aspects of criteria. The essential arguments of the defense of a social rate of discount to be used in conjunction with the social opportunity cost of capital are those contained in the earlier papers of Marglin.

This slim volume is not a handbook for the benefit-cost practitioner, but an introduction, closely linked to welfare economics, to a handbook. Its scope, balance, and theoretical underpinnings are based on a tradition of several decades of interaction among economic theorists, administrators of water resources projects, and economic advisers to engineering managers. In recent years the pioneering benefit-cost studies have become the mature parts of a loosely structured set of studies called systems analysis. Do these developments carry a moral for the classic statement presented by Marglin?

Two key questions of the systems analyst are: what is the decision, and who is the decision-maker? Benefit-cost analysts have become sophisticated about the first question, but they have been indifferent to the second. The initial thrust of the studies was to establish an economic justification for a proposed project; today it is recognized that the studies should be an integral part of the evaluation of alternatives, so as to lead to a better choice among projects as well as the design and scale of a project. A decision has replaced a justification. But implicit in the Marglin essays is the assumption that the decision-maker is a self-conscious agent of the national interest. The criteria, even when they refer to regional benefits, are formulated in terms of a "national objective function." The classical benefit-cost analyst is the economic scientist working for society's welfare, not a staff man of a decision-maker. Consistent with this focus on national objectives has been an indifference to organizational issues. The source of finance enters as a budget constraint and as a factor in estimating the social opportunity cost of investment, but the complex set of constraints which derive from the institutional structure of budget formation

and control are not considered. Consider how differently the administrators of the following types of agencies would respond to criteria derivable from welfare economics: a self-financed public corporation, a grant-giving bureau, or a construction agency dependent upon local political support. The neglect of organizational issues by the classical benefit-cost studies has weakened the support of administrators, but it has strengthened the political position of economists as a pressure group for bureaucratic reform.

The most dramatic difference between systems analysis and Marglin's classic benefits-costs studies is the attention given to uncertainty. Uncertainty about objectives, constraints, costs, and benefits is all-pervasive in the systems framework, and extensive attention is paid to the best ways to characterize the uncertainty, the evaluation of risk aversion, and a strategy of contingency planning. The classic benefits-costs studies follow in the tradition of economics: an extensive analysis under certainty, followed by an embarrassingly thin addendum under uncertainty.

Benefits-costs and related studies are going to become increasingly important. Every economist will find it rewarding to read this slender volume, which is the best succinct introduction to the studies most closely linked to welfare economics.

JULIUS MARGOLIS

*Stanford University*

### International Economics

*Free Trade between the United States and Canada—The Potential Economic Effects.* By RONALD J. AND PAUL WONNACOTT. Cambridge: Harvard University Press, 1967. Pp. xx, 426. \$9.00.

In this volume, the Wonnacotts investigate the effect on the Canadian economy of a hypothetical removal of all restrictions upon trade between that country and the United States. The impact upon the U.S. economy is dismissed as being quite insignificant. Part I consists of ten chapters and is concerned with an empirical analysis of comparative production costs between industries and regions in the two countries, the primary emphasis being on absolute advantage. The single chapter of Part II deals with the potential effects on production costs and the extent of specialization resulting from the adjustment to free trade. In Part III, the incidence of U.S. and Canadian tariffs with respect to input prices, economies and diseconomies of scale, and oligopolistic pricing policies are examined. In Part IV, policy recommendations, conclusions, and possible extensions, e.g., factor mobility between the two countries, are presented. Finally, the book is rounded out with 85 pages of appendices.

The Wonnacotts begin their analysis by attempting to estimate the importance of lower Canadian wage levels insofar as the possible expansion of Canadian industry arising from the introduction of free trade is concerned. They conclude that wages in industries located in the United States are sub-

stantially higher than those in the same Canadian industries, the differences in the actual labor costs of finished products are substantially smaller, particularly in those industries which are capital intensive. Although no attempt is made to test empirically the extent to which the wage differentials are due to productivity differences, the authors assert that these are probably not significant so that Canadian based industries do enjoy a wage advantage over their U.S. counterparts.

From the standpoint of industrial location, including proximity to markets and input sources, Ontario and (to a lesser extent) Quebec are held to have an absolute advantage over much of the United States, exceptions in some categories being the Great Lake, Middle Atlantic, New England, and possibly West Coast regions of the United States. It is held that higher capital costs in Canada are due to the existence of trade barriers and exchange rate risk and would be largely eliminated with free trade, although this advantage might be partly offset by the necessity of higher taxes in Canada as a result of losing substantial tariff revenue. Insofar as comparative advantage is concerned, the authors take issue with the frequently stated thesis that Canada has an absolute advantage in material production and a disadvantage in manufactures and conclude that free trade would increase Canadian specialization within some broad manufacturing sectors and that the Canadian dollar and money wage rates would probably adjust to comparable levels with those of the United States, with the exception of wages in the northern section of the United States.

In Part III, 16 sample industries are examined in some detail from the standpoint of attempting to determine how much of the Canadian-U.S. cost differentials can be attributed to tariffs, the objective being to estimate the extent of those cost reductions and efficiency increases which would arise as a result of trade. This is accomplished by first adjusting the observed price differentials of the products in question for differences in labor costs, etc., yielding an estimate of the advantage derived from producing and selling the product in Canada. This remainder is then disaggregated into a component which is directly dependent upon tariffs and a cost residual which is attributed to the diseconomies associated with producing for a limited Canadian market. For most of the sample industries the tariff-induced costs are estimated by applying Canadian tariff rates to all imports and import-competing products which are utilized as inputs for the sample industries. As noted by the authors, this method tends to overstate the Canadian costs. It is argued that both of these costs would tend to disappear under conditions of free trade, giving the sample Canadian industries an absolute cost advantage. When the results are adjusted for economies-of-scale considerations, including both technical and market factors, the authors conclude that over half of the tariff costs borne by Canadian industry is a consequence of U.S. trade barriers. Unfortunately, this result, as well as some of the other empirical findings, appears to be subject to a number of qualifications, e.g., "if," "it is possible," etc., and the reader may sometimes suspect that some of the conclusions would be subject to modification if sampling errors were taken into account.

Policywise, step-by-step Canadian tariff reductions over a ten-year period are suggested in order to permit the adoption of embodied technical change which would be necessary to make Canadian industry competitive in a free trade situation. Immediate tariff elimination is held to be feasible for the United States due to the relative insignificance of U.S. imports from Canada. Moreover, some short-run assistance to especially hard hit Canadian industries and displaced workers may be in order.

In conclusion, this book is a largely quantitative analysis of the economic effects of eliminating trade barriers between two specific countries and, as such, is the most intensive study of its type yet done. While econometricians and input-output enthusiasts may not be ecstatic about the statistical techniques or data used (and sometimes not used), the Wonnacotts have done a competent job on a difficult problem. Even if a greater degree of rigor is desirable in some areas, the analysis still provides an admirable target for the next study of its type.

PAUL E. SMITH

*University of Missouri*

*European Economic Integration and the United States.* By LAWRENCE B. KRAUSE. Washington, D.C.: The Brookings Institution, 1968. Pp. xiv, 265. \$6.75.

Since the establishment of the European Economic Community (EEC) and later the European Free Trade Association (EFTA) there has been substantial hypothesizing as to the impacts of these ventures on nonmembers. These theoretical explorations have been supplemented by various attempts to quantify particular, specific effects (usually of the EEC's formation). This book provides the first, comprehensive, empirical estimate of the initial impact of European economic integration. Comprehensiveness is attained by including estimates of both EEC's and the EFTA's impacts and by testing or exploring the complete range of hypothetical results of integration.

After providing the necessary background data and overviews of the EEC's and the EFTA's experiences in Chapter One, the impact of integration on trade in manufactured goods is explored in Chapter Two. Noting that the "major factor determining the growth of trade of manufactured goods is . . . real income growth," Krause demonstrates that "all the EEC and EFTA countries (other than Austria) had higher growth rates after integration than during the 1953-1958-59 period." One effect of the accelerated growth is that business investment as a per cent of gross domestic product increased for all countries of the two integration schemes since the start of the transition periods. Although noting that integration-induced growth's impact on increased efficiency is more difficult to measure, it was found that all member nations grew more rapidly as a result of increased efficiency. These two estimates were added together to provide an estimate of the "total increment to income attributable to economic integration . . ." The median increase in the compound, annual growth rate was 0.19 per cent for the EEC and 0.16 per cent for the EFTA. Since the EFTA's more rapid integration should have

had the larger impact, the empirical evidence is said to indicate that the two organizations had differing experiences solely because of the EEC's gains in efficiency. The large size of the EEC's member nations and the avoidance of wasteful transportation costs are identified as being key to the differential efficiency experience.

The effects of discriminatory tariff changes on trade patterns in manufactured goods is next considered. (In general this is a measure of the conventional trade creation, trade diversion-type effect. The emphasis on trade patterns is probably realistic in that hypotheses based on the rigorously defined concepts are probably empirically untestable.) Three approaches were used to make the relevant estimates. The first provided estimates that during the relevant transition periods imports of manufactured products from non-members would be \$975 million less into the EEC and \$828 million less into the EFTA than if no integration had taken place. The second direct estimate yielded a statistically significant estimate that 50 per cent of the EEC's adjustment to the new equilibrium had been accomplished by 1965. Less statistically significant was the estimate that 15 per cent of the EFTA's adjustment had been completed by that year. The indirect estimate indicated that the intra-EEC share of total trade was 7.1 percentage points larger and intra-EFTA share of total trade was 2.7 percentage points larger than the expected pattern in the absence of integration. (In additional to a statistical appendix, two appendixes explain the method of measuring income effects and trade pattern effects.)

Combining the first direct trade pattern effect with the income effect, the estimate is made that the net losses in sales of manufactured goods for non-members caused by the EEC would be \$548 million over the transition period. The losses caused by the EFTA's creation were estimated to be \$597 million. If offsetting EEC-EFTA losses are subtracted, the rest-of-the-world's total loss of sales of manufactured goods resulting from the two integration schemes is estimated at \$587 million over the transition period.

Agricultural trade is analyzed in Chapter Three. Since the EFTA has no common agricultural policy, emphasis is on the EEC's impact. In surveying pre-EEC, national agricultural policy, the increased agricultural self-sufficiency of the area is noted. Other than assuming that incentive pricing would have been abandoned and that a free market was unlikely there is no suggestion as to what sort of agricultural policy would have prevailed in the absence of the EEC. Alternatively the Common Market's formation is said to have provided a stimulus toward self-sufficiency. It was estimated that by 1963-64 the total integration-caused reduction of nonmembers' agricultural exports to the EEC was \$340 million (at world rather than EEC prices). This is a relative loss (actual experience versus what might have been). There is not likely to be an absolute decline in agricultural imports from non-members.

Chapter Four examines the influence of European integration on U.S. direct investment. The parallel, substantial increases in the EEC's and the EFTA's shares of total U.S. direct investment are taken as empirical evidence "that European integration has been an important determinant of U.S. direct investment . . ." Although the major western European countries' return to

currency convertibility on December 29, 1958 is later noted, additional institutional changes which have affected western Europe uniquely since 1958 have been ignored by Krause. For example, Walter Salant in his *The United States Balance of Payments in 1968* (pp. 122-24) mentioned the following: formal acceptance in April, 1961 of the Bretton Woods agreements Article VIII by western European nations, internationalization of businessmen's attitudes, the relative increase in military vulnerability of investment in the United States relative to Europe, and the relative decline of political risk in Europe compared to the rest of the world. Salant took the position that these factors together with integration have shifted U.S. investment both absolutely and relatively toward Europe. In such a list integration is but one influence. This reader doubts that the specific impact of each of these institutional changes can be identified, much less empirically estimated. Nonetheless a review of the list may have prompted a decrease in the degree of certitude as to integration's impact. After finding the EEC and the EFTA total U.S. direct investment experience practically identical, the hypothesis was modified to state that manufacturing investment is the most sensitive to the stimulus of economic integration. Krause found that the data affirmed this hypothesis.

Chapter Five deals with internal problems of the integration organizations. Included are antitrust problems, patents and trademarks problems, energy problems, tax harmonization, and general economic policies. Chapter Six is entitled "Foreign Relations" and covers Finland's Association with EFTA, the EEC and the Associated Overseas Countries, Nigeria's association with the EEC, other possible African-EEC associations, EEC agreements with European countries, future possibilities of EEC expansion in Europe, EEC commercial agreements with other countries, and tariff negotiations with the United States. In general the history to date of each of these matters is surveyed. Empirical analysis similar to that undertaken in earlier chapters is not attempted. Provided instead is a concise analysis which should be useful to anyone beginning a study of one of these topics.

As the above description implies, I consider the empirical evaluation of European integration's impact on the rest of the world in general as the major contribution. In my view, the evaluation of the impact on the United States is an important but secondary (regardless of the title) contribution. (Lest the reader of this review gets the wrong impression, Krause definitely does not get carried away with his computations. In his words, "Because of the nature of the question, cause-and-effect relationships have been inferred rather than observed. This should serve as a warning to those who would take numerical estimates in this study too literally.") The description also indicates that the book is thorough in coverage. Although the statistical technique is not extremely complex, the analysis is likewise very complete.

This leads to the summary appraisal that it is a good book. Further, as indicated at the beginning, it is essentially a pioneering effort. An empirical evaluation of integration's impact is available nowhere else in such comprehensive form. This book will therefore serve as a model for similar future studies, as a point of departure for others, as a catalyst upon which divergent opinion can be focused, etc. Thus this work will be invaluable in particular

to everyone interested in economic integration and in general to everyone involved in the testing of economic theory and/or the formulation or evaluation of economic policy.

ANTHONY SCAPERLANDA

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*Studies in Trade Liberalization.* By BELA BALASSA AND ASSOCIATES. Baltimore: The Johns Hopkins Press, 1967. Pp. xiii, 346. \$11.50.

This book contains a series of nine studies on the problems of, and prospects for, trade liberalization among industrial countries. It is addressed to practical men of affairs as well as to academic economists. Following a methodologically oriented introduction by Balassa, under whose direction the book was prepared, the series contains six area or country studies: on the United States, by Mordechai E. Kreinin; Canada, by Ronald J. Wonnacott; the Common Market, by F. Hartog; the United Kingdom, by Sidney J. Wells; Scandinavia, by Staffan B. Linder; and Japan, by Kiyoshi Kojima. The final two chapters contain problem-oriented studies, the first on fiscal and social barriers to integration, by Douglas Dosser, and the second, by William B. Kelly, Jr., on nontariff barriers.

The major effort in the country studies is concentrated on the effects on trade of an Atlantic Free Trade Area (including Japan), and, alternatively, of a 50 per cent across-the-board tariff reduction by industrial nations. Some implications of a trading arrangement among non-EEC industrial countries and of European integration are also considered. Estimates are made of the possible effects of tariff reductions on trade flows and, in some cases, on foreign investment. In estimating the effects on exports and imports, the general procedure is to calculate import and export demand elasticities using available statistical estimates of the demand and supply elasticities of the goods in question (or a relevant category of goods) and combining these with estimates of the ratios of internal consumption and production to imports to obtain excess demand elasticities. The supply elasticities of exports and imports are assumed to be perfectly elastic, except in Western Europe where alternative estimates are calculated assuming that export prices rise by one-third of any tariff reduction. The relative change in the import price implied by the reduction of the tariff is then applied to the import demand elasticities. In addition to the calculation of the impact of tariff reductions on trade flows, attention is devoted to the effects of trade liberalization on the industrial structures of the countries involved. A common procedure for all of the countries is to use "export performance indicators" and "export-import ratios" for particular categories of products. A conclusion appearing in a number of studies is that adjustments would take the form of greater international specialization within industries rather than the demise of whole industries within particular countries.

In evaluating works of this kind it is useful to ask: What does this contribute to our understanding of (a) how the international economy works; (b) how to evaluate the potential gains from making it work more efficiently;

and (c) how to go about achieving these gains in efficiency? Or, to phrase the question differently, given the results of this book, what do we know that we did not know before, and what would we do differently now that this information is available?

Certainly, anyone who reads this book will have a far clearer understanding of the possible quantitative effects of trade liberalization on trade flows and what distribution effects might occur within the economies as a consequence of the reduction of tariffs. But suppose we knew this perfectly. What does the information contribute to economic policy? Unfortunately, the answer seems to be, "Very little." In the first place, the entire approach is geared to the effects of tariff reductions on the balance of trade rather than on the terms of trade, and it is the latter that must be known to determine the magnitude of potential gains from liberalization and whether they are worth the costs in terms of political and other objectives. Moreover, the general tenor of the book tends to reinforce the tendency, particularly among non-academics, to slip into the habit of viewing trade liberalization as a race between exports and imports in which imports are viewed as a cost of being able to achieve the benefits of expanded exports. As a result, the possibly substantial benefits to countries like Canada from the improvement of resource allocation consequent upon a unilateral move to free trade get ignored, as well as the question of how long a country should suffer losses from its own tariffs while waiting for such improvement in its terms of trade as may eventually come from a reduction of foreign tariffs. Moreover, the analysis presented here of the effects on the structure of industry—while of some interest as straight factual knowledge and of some use in suggesting the costs of liberalization and the areas in which compensation could be made—neither negates nor reinforces the argument for liberalization of trade. There is some *a priori* reason to suppose that the more painful and socially costly are the resource readjustments required, the bigger the potential gain from making them.

With respect to the individual papers, it is rather easy to find theoretical confusions in all of them, although their primary function of providing information is not impaired significantly as a consequence. For example, in the U.K. paper we are told (p. 144) that the performance of the office machinery industry is "disappointing" because it does not specialize in electronic computers; with respect to machine tools, "concern" is expressed because the United Kingdom tends to export simpler machines and import complex ones. Why should one be disappointed and concerned? There is room for specialization, and not all countries need produce electronic computers. Every country has a comparative advantage in something.

Wonnacott (p. 63) slips into the more sophisticated error of regarding future changes in the exchange rate as a risk factor affecting U.S. investment in Canada. This ignores the fact that balance-of-payments equilibrium must be maintained in any event by relative internal cost, if not by exchange rate movements, under continuous full employment conditions. Such relative cost adjustments are no less important for investment in a particular province in



Canada than in a particular state in the Union. Despite this error, the paper is, in the reviewer's judgment, the best of the lot—well organized, lucid, and on the whole theoretically sound. In the Common Market paper, Hartog argues (p. 106) that European governmental research should be undertaken to offset the advantages American firms receive from that source. Governmental research should be evaluated on the basis of costs and returns rather than on the fact that foreigners are doing it. It does not pay to subsidize exports just because other countries do.

Aside from a number of such theoretical slips in a generally nontheoretic approach, this book has much to recommend it to the reader who wishes to obtain some basic information about the possible effects of trade liberalization on the economic structures in the countries in question. The last chapter should also be of considerable use to those in search of a compact but extensive discussion of existing nontariff barriers. Given what it tries to accomplish, the book is generally of quite high quality and a useful addition to the library of economists interested in this area.

JOHN E. FLOYD

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*Monetary Reform and the Price of Gold.* Edited by RANDALL HINSHAW. Baltimore: The Johns Hopkins Press, 1967. Pp. x, 180. \$6.95.

A conference was convened in Bologna in early 1967 under the auspices of The Johns Hopkins' School of Advanced International Studies to discuss the interrelated problems of world monetary reform and the price of gold. Its proceedings are brought together in this book: there were studies presented by recognized specialists on the recent growth in international reserves and the effects of a higher gold price on gold output, and on private gold demand; Rueff, Triffin, and Bernstein explained their proposals for reform in detail; and Lord Robbins presented two masterly surveys of the field, first, to introduce the expert discussion and, later, to summarize the discussions at these meetings.

Comparisons of the reform proposals of these three distinguished advocates, and the cross-questioning and debate among them, emerge as the useful contribution of this book. Rueff is concerned to eliminate the gold-exchange standard in order "to create a situation in which the deficit country will lose what the surplus country gains." (p. 40). He suggests an international convention in which countries would agree: (a) to cease adding to their dollar and pound holdings and, instead, use only gold for international settlement; (b) to "approximately" double the price of gold; (c) to have the United States and United Kingdom use their gold profits to repay immediately in gold their liabilities to central banks; and (d) to provide long-term credits to the United Kingdom to repay outstanding sterling balances.

To Rueff, the main question is not the price of gold but the need to establish a payments system in which aggregate demand is made sensitive to the balance-of-payments position in each country. Thus, he would cure the U.S. deficit by domestic deflation; to him, a program to reduce foreign

spending directly "only reduces the surplus in the balance of trade and does not re-establish equilibrium" (p. 39).<sup>1</sup>

Although Triffin's diagnosis of the sources of current international financial instability finds much common ground with Rueff's emphasis on the gold-exchange standard, he cannot accept the notion of an "automatic system" in which countries could "escape responsibility for managing their own affairs" (p. 49). Instead, Triffin is seeking "to design expedients" which would accelerate the evolution of the payments mechanism in the direction of centralized reserves at an international institution—a development which he regards as historically inevitable.

Because it will satisfy his ends, Triffin finds the Bernstein prescription to be generally congenial. Under Bernstein's proposal, Reserve Units would be created by international agreement to ensure "a moderate, regular increase, equivalent to what we would have had if gold production were adequate to the monetary needs of the world" (p. 162). These Reserve Units are "composite foreign exchange assets" of the currencies of participating countries, to be issued through the IMF at annual rates agreed upon for periods of five years. Distribution would be in proportion to quotas at the IMF and participating countries would accept them for payments settlements.

World events have moved rapidly since this conference was held. In early 1968, just after this book was released, the leading industrial countries were able to complete two important international financial agreements which had the effect of resolving—for the moment, at any rate—the two main issues debated at the conference. Instead of a rise in the gold price, the major "gold pool" countries agreed in Washington in mid-March to hold the \$35 price for official gold transactions and stated that "they no longer feel it necessary to buy gold from the market."<sup>2</sup> In this way, current gold output—too limited for both official and private needs—would be reserved to meet private demand and the private gold price would be allowed to fluctuate in response to demand and supply conditions, with official supplies no longer being placed in these private markets.

In early April, in a complementary step designed to ensure an orderly growth in official reserve assets to supplement gold holdings, the G-Ten countries (excluding France) agreed to activate a facility for deliberate reserve creation under the Fund. Amendments to the Fund's Articles to put this scheme into operation were published on April 22<sup>3</sup> and are now being ratified by Fund members. The Special Drawing Right facility is kin to—but with some differences from—the Reserve Unit Proposal. A major difference

<sup>1</sup> However, the deterioration of the U.S. trade balance since late 1964 has been due to an accelerated rise in U.S. imports and not to any slowdown in the rate of export expansion. Thus, U.S. exports rose by 8.0 per cent per annum between 1960-61 and 1964-65 compared to 7.9 per cent from 1964-65 to 1966-67. (See "U.S. International Transactions: Trends in 1960-67" in *Federal Reserve Bulletin*, April 1968, Table 3, p. 347.)

<sup>2</sup> See "Meeting of Governors of Central Contributing to Gold Pool: Communique" in *Federal Reserve Bulletin*, March 1968, p. 254.

<sup>3</sup> "Proposed Amendment to Articles of Agreement," International Monetary Fund, April 1968.

stressed by Bernstein is that management is to be by Triffin's Group of 105 rather than by Bernstein's Group of Ten: on this point, he noted, "I have lost and Triffin has really won" (p. 163).

This measurable progress in monetary reform has brought international financial discussions a step beyond the body of the materials in this book. But these agreements can be consolidated only if the Free World countries are able to master the difficulties of the major adjustment in world payments which must now be achieved as a matter of some urgency: the transition from a position of large surpluses in Europe and large deficits in the United States to one of much greater balance on both sides of the Atlantic. Unfortunately, much of the diagnosis in this book is focused rather narrowly on international reserves and liquidity, on the price of gold, and on the inequities of the gold-exchange standard rather than on the problems associated with a process of mutual transitional adjustment between the two sides of the North Atlantic trade and payments area.

To be sure, Emminger has a valuable chapter on the difficulties of payments adjustment in the modern world. In reaction to the Rueff-Triffin emphasis on the gold-exchange standard as the basis of our financial difficulties today, he pointed out that "the gold exchange standard for all practical purposes has been dead since 1964" (p. 100) and that the return to "a pure gold standard has not had any perceptible impact on the balance-of-payments-adjustment policies" of the United States. He could only conclude that we "need more than just a return to the pure gold standard in order to improve balance of payments performance in this world" (p. 101).

Our present challenge is whether we can achieve adjustment toward balance at a rate sufficiently rapid to ensure that the recent financial agreements can become an historic turning point in the evolution of the world's payments system, and not merely temporary improvisations swept away by subsequent crises. For this reason, Meade's comment is worth repeating:

I am saddened at the sight of so many people in such positions of great responsibility, and in such positions of intellectual and academic influence in these matters, spending such a high proportion of time discussing the differences—which I admit are very important, between the various ways of controlling and increasing international liquidity—relative to the proportion of time which they have given to what in my view is the much more important problem of how the countries in the free world—the developed, industrialized, liberal countries of the Atlantic community, if you like—adjust their payments to each other (p. 122).

As we consider the question of how countries can improve adjustment performance during this period of transition—with its historic implications for international relations within our western world, as well as for our liberal trading and payments system—one can share some of Meade's regret that the question of international liquidity, rather than that of international adjustment, has occupied the center of professional attention for so many years.

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**Business Finance; Investment and Security Markets; Insurance**

*Investment Banking and the New Issues Market.* By IRWIN FRIEND, JAMES R. LONGSTREET, MORRIS MENDELSON, ERVIN MILLER, AND ARLEIGH P. HESS, JR. Cleveland: World Publishing Company, 1967. Pp. x, 598. \$12.00.

This volume reports results from studies about the activities of investment bankers conducted by the Securities Research Unit of the Wharton School. After a useful introductory chapter by Professor Irwin Friend, the remaining seven studies can best be viewed as one subset of three essays by Professor Ervin Miller about the nature of the American investment banking industry and another subset of four essays by the remaining contributors about the new issues market.

The introductory chapter summarizes contributions in the volume quite effectively for the general reader. In this chapter Friend also defines basic concepts such as "new issues" and "operational efficiency" and sketches a useful history of gross and net flows of securities during the twentieth century. His survey is clearly presented and interesting, although one should complain about the looseness of his definitions. Thus, "*operational efficiency* relates to the extent to which the necessary investment banking services can be provided at minimum cost" (p. 7). His history concludes that over the long run greatly increased personal and corporate tax rates, rapid growth of state and local debt, and increased noninvestment bank intermediary competition have changed the game profoundly.

Miller's three chapters respectively review the background and structure of the industry, activity in the industry, and industry inventory positions and practices. The first describes the regional development of investment banking in the nineteenth and twentieth centuries, clearly recognizing the great difficulty of defining the extent of this industry. A disturbing aspect of his empirical work is that of about 2900 firms relevant to his analysis only some 15 per cent reported that investment banking was their primary activity. A cynic might conclude that the construction of an investment banking industry is not analytically insightful; behavioral relationships are never easily perceived in multiple product (service) situations, especially when attention is focussed on a small part of the product.

Cynics aside, in his chapters Miller reports an impressively large number of two-way summary tables about firms concerned with investment banking; utilizes data collected from previously published sources and from a sample survey which he conducted; and examines differences in firm activity over time and across region and firm size.

He is not on very solid ground when emphasizing concentration ratios and firm size variables because of the aforementioned weakness in industry definition. Also he finds that between 1949 and the first quarter of 1962 investment bank inventories of both new issues and outstanding securities fell. He attributes this to the booming 1962 first-quarter security markets. An alternative explanation is associated with the fact that interest rates were high

in 1962 relative to 1949. Finally, readers must interpret results cautiously for much behavior can unintentionally be concealed when only pairwise relationships are exhibited.

Indeed, apart from a sojourn into the rough waters of regression analysis by Morris Mendelson, who studied underwriting compensation, a serious deficiency of all the papers in this volume is that they summarize nearly all relationships in two- or three-way tables. This reporting strategy is particularly regrettable in the case of Miller's sample survey and in Chapters 5 and 6 by Longstreet, Mendelson, and Hess. The latter two chapters studied quite detailed data about 12,000 rather heterogeneous new issue transactions. The world is multivariate; theory and statistical methods are capable of suggesting and confirming subtle multivariate relationships. Apparently data selection was not based on a carefully specified underlying theoretical framework. Even if theoretical agnosticism dictates pairwise comparisons of variables, the authors could have suggested the statistical significance of their research by reporting evidence in a form suitable for chi-square tests.

Among the conclusions of Chapters 5 and 6 is that pronounced regional specialization exists in the demand for new issues; the South has a relatively strong preference for corporate bonds. Other findings are that (1) commercial bank trust departments are principal purchasers of new common stock issues, (2) new issue common stock transactions are very much smaller and more numerous than transactions in corporate or municipal securities, and (3) private placements and public offerings of new corporate securities have grown roughly proportionately in the postwar period.

Mendelson reports that the underwriting commission percentage or "spread" is very significantly negatively related to the issue price in each of four years studied; he suggests that firms issuing stock for the first time may have a strong preference for low price issues. His results suggest that significant shifts in the determinants of this percentage occur over time.

In the last chapter Friend and Longstreet conclude that allocational efficiency of the new issues market is reasonably high. They report that new issues do not have a higher *ex post* rate of return than existing securities and suggest that this casts doubt on the generally accepted view that investors are risk averse.

In conclusion, this volume reports an extensive research undertaking which is rich in tables and institutional detail; it lacks a well-defined subject and well-developed theory and statistical analysis. It is not strongly recommended.

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*Issues in Defense Economics*. Edited by ROLAND N. MCKEAN. New York: National Bureau of Economic Research; Columbia Univ. Press, distrib., 1967. Pp. xi, 286. \$7.50.

Reviewing a volume containing papers by eight authors in the number of words allowed by the *AER* is not easy; the reviewer finds it even more diffi-

cult if the volume, as in this case, contains built-in reviews of each of the papers in the form of comments by a dozen economists who participated in the Universities-NBER Conference at which the papers were originally presented. Faced with this rather dispiriting task, I will content myself with a brief run-down on the main topics covered, adding a few remarks stimulated by this volume.

First and most important, however, Roland McKean, who chaired the Committee responsible for organizing the conference, gets high marks for selecting a good group to prepare the papers plus a high-quality group of formal discussants.

This volume is divided into three parts. Part I, Applying Economic Concepts to Defense, leads off with a paper by Malcolm Hoag on "Increasing Returns in Military Functions." Hoag takes off from Lanchester's Law which suggests that numerical superiority of force at any point of actual combat is crucial to determining outcome—or, in economic terms, that there are returns to scale in developing and deploying military forces. From this Hoag cautions the systems analyst to beware lest the wrong suboptimization with a focus on marginalism be badly misleading. He expresses sympathy for military officers whose instincts have sometimes told them that the hot-shot "whiz kids" from RAND *et al.*—more recently infiltrated into the very heart of the Pentagon—can sometimes be terribly wrong, precisely because they ignore the very real truth contained in Lanchester's Law. Note, however, that the "whiz kids" (according to Washington lore) made at least one major set of recommendations which was pure Lanchester: the Fast Deployment Logistics (Air Lift-Sea Lift systems mix) capabilities now being developed is based on the notion that the United States should be able to bring massive force to bear quickly at a point of conflict anywhere in the world. Hoag is right in his major arguments, and he presents some instructive examples to make these arguments.

The Mancur Olson-Richard Zeckhauser piece, "Collective Goods, Comparative Advantage and Alliance Efficiency," spends most of its words demonstrating that Pigou was right after all in asserting that goods and services which qualify as public or collective goods (because of the pressure of significant external economics) will be undersupplied, from a social optimality standpoint, if sole reliance is placed on individual action in a free market setting. On the application of their restatement of the theory of collective goods to defense alliances (and specifically to NATO), I find myself in agreement with several of the comments, especially those by Richmond Cooper and Jacques Van Ypersele de Strihou. Olson and Zeckhauser suggest that the defense supplied by alliance (e.g., NATO) forces is a public good for the members of the alliance and that therefore efficiency considerations require each to provide that part of the force in which it has a comparative advantage. Yet, in NATO (and most other alliances), surely the defense provided is only partly a collective good and each member will recognize its "private" interests which are not congruent with the alliance interest. Only if deterrence, provided by NATO, for example, can be 100 per cent effective,

are NATO defenses a pure public good to NATO members. If forces have to be used, not all nations will be equally protected and national (vs. alliance) interests will diverge.

The second group of papers is entitled Strategy and Resource Allocation. Jerome Rothenberg discusses "Strategy, Arms Control and the Deployment Defensive Weapon Systems," Thomas Schelling, "The Strategy of Inflicting Costs," and Martin McGuire, "The Structure of Choice Between Deterrence and Defense." All of these papers are provocative and include many revealing suggestions and useful ways of considering some of the very tough issues facing us today. Indeed, this section might almost have been called, "Do we want an ABM System?" None of the authors is ready with a clear-cut answer—but one can infer that none would endorse the Administration's apparently reluctant decision of last year to proceed with a "thin" ABM system for the United States. Various points in all three of these papers certainly buttress the view of those who question our present posture in this regard—including those who *would* support a full-fledged \$40–50 billion missile defense system (including especially shelters) as well as those who think deterrence is most apt to work if we don't have an ABM capability. (Hoag, in his paper referred to above, does use ABM as an "increasing return" example and he *does* suggest that a "thin" system makes little sense.) These papers also give added weight to those who, like ex-Defense Secretary McNamara, argue that simple comparisons of the numbers of missiles and bombers on our side and on the "other" side are almost bound to be misleading and rarely, by themselves, a useful guide to defense policy-making. If the U.S. missile system is such that enough striking power will survive any first strike of which, say, the Soviet Union is capable so that our surviving second strike capability will destroy most "interesting" Russian targets and inflict tens of millions of casualties, then it is not necessary for us to strive for *numerical* superiority—and, of course, such striving can be frustrated if the Soviets act to the same end. Indeed, it can be argued that some narrowing of the gap between our strategic offensive capability and the Soviet's is a desirable *strengthening* of mutual deterrence to nuclear war, since she can more confidently resist any temptation to strike *first*, the more secure is her *second* strike capability.

I found the comments on these papers by Robert Eisner especially arresting. Proclaiming himself as an "outsider" in conference with a group of authors (and other discussants), most of whom had had more or less lengthy "inside" experience (at RAND and RAND-type places as well as in the federal establishment itself), Eisner questions some of the basic premises implicitly accepted by most of the authors. One troubling Eisner point: Is it always correct to assume an identity between the basic objectives of the key decision-makers (e.g., the President) and the public at large? For example, will a President not be tempted to evaluate risks somewhat differently than the public—if, for example, a relatively risky step might mean nuclear attack, but, if successful, might also promise a stunning victory for him and his Administration? Does the systems analyst work solely for "the Boss," ac-

cepting his value judgments and priorities; or, in a democratic society, does he have a higher duty to reflect, as best he can, society's values and priorities, should these diverge? Some will be offended by Eisner's probing of this point; others will dismiss it as not a real problem (though conceding it *could* exist—and asserting its applicability to totalitarian states); but, I confess that I am troubled by Eisner and think we can't dismiss him out of hand on this point.

The last group of papers deal with Institutional Structures and Defense Spending. Martin Bailey explores present and potential uses of the market mechanism within the Defense establishment. James Schlesinger's essay examines some of the centralization-decentralization issues highlighted by the "McNamara Revolution" in DoD. He contrasts two approaches to planning—"Cook's Tour" (where a single course is carefully laid out in advance) and "Lewis and Clark" planning (which "keeps options open"). Schlesinger has some provocative, though inconclusive, things to say about the value of dissent in bureaucracies like DoD and the problems of getting the optimum kind and amount of dissent without demoralizing the system. Oliver Williamson examines the principal form of decentralization found in the defense establishment of this country: the primary reliance on private firms to produce the weapon systems and ancillary equipment required by modern military forces. He makes the interesting point that the shift from CPFF (Cost Plus Fixed Fee) to incentive-type contracts can best be viewed by understanding its implications for the relationship between the various parties involved in military procurement: the contractors, the military services, and the "higher authorities" (the Secretary of Defense and his Office, the Bureau of the Budget, and the President). CPFF can be viewed as a device used by the typical coalition between the contractor and the Service, formed so as to force their joint will on the OSD. Incentive-type contracts are useful to the higher authorities in part because such contracts encourage the production of more realistic cost estimates—and cost estimates play a vital role in choosing among weapon systems.

This volume is a useful addition to the growing body of work by economists who have applied their talents and expertise to problems of national security and defense. Like all such collections of papers prepared for a conference, there is a certain unevenness in the quality of the papers and in the formal remarks of the discussants, and there is little relationship among the three groups of papers. As is true with much of the work written by economists normally concerned with defense issues, those interested in the application of the tools of economics to nondefense government issues can find much that is useful in the present collection of papers, especially in the last group of papers dealing with organizational and institutional issues, although not one paper presented here is directly germane to the current Washington preoccupation with PPBS (Planning-Programming-Budgeting-System) on the nonmilitary side of government.

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*Soviet Metal-Fabricating and Economic Development: Practice versus Policy.*

By DAVID GRANICK. Madison: University of Wisconsin Press, 1967. Pp. xiv, 367. \$8.50.

Professor Granick has written a thoughtful and provocative analysis of Soviet industrialization experience during the key development years of 1928–1937. His case study also analyzes the impact of this early period upon development policies through the early 1960s. Massive investments were made in the machine tool and equipment industries during the 1930s. The investment strategy was to concentrate available resources on large-scale, specialized plants utilizing the most advanced production techniques. Granick argues that this calculated effort to take a great leap forward in the 1930s was premature and resulted in widespread underutilization of scarce resources. This was due to both technological and organizational gaps over a prolonged period. First, there were widespread and prolonged deficiencies in supplier industries upon which the large-scale, specialized plants depended for critical materials and parts. Secondly, under the planning frame of the 1930s and subsequent periods, plant managers were impelled toward a product mix and a degree of vertical integration which ran counter to the overall planning strategy.

On the first of Granick's arguments, Soviet planners believed that the capital equipment associated with the more advanced continuous-flow techniques, which were then being introduced in American and European metal-fabricating industries, could not substitute for acknowledged deficiencies in skills and industrial organization. These advanced techniques required standards of quality control and interplant scheduling that were far beyond existing sector capabilities. There were also widespread deficiencies in technical and managerial skills during this period. Under these circumstances, Granick argues, it would have been more advantageous to introduce intermediate scales and techniques during this earlier period and later move into the more sophisticated technologies and industrial structures. This would have allowed time for the indispensable skills and industrial capabilities to be developed and the necessary adjustments in planning practice and managerial behavior at the plant level to take place.

As for the second argument, considerable capital wastage occurred during the earlier period due to the widespread tendency toward excessive vertical integration at the plant level, which resulted from efforts by plant managers to offset widespread supplier deficiencies and meet production quotas. Under the planning frame, cost and quality considerations were also neglected. (An analogous situation exists in the seller's market created by protection and import control systems in developing economies.) In their efforts to sub-optimize, Soviet plant managers were subverting the long-term goals of growth and productivity gains that Soviet planners hoped to achieve through specialized production among interdependent plants.

As Granick himself points out, his analysis suggests (but does not prove) that Soviet strategy during this period was not an optimal one. (This is at least true of an *ex ante* basis, given the structural deficiencies that prevailed during this period.) But much may be drawn from the Soviet experience that is

relevant to the industrialization problems of developing economies. To begin with, the Granick analysis raises basic questions on the advisability of an all-or nothing push into industrialization with a heavy reliance upon capital-intensive techniques. A major thrust of the Granick thesis is that the premature introduction of advanced techniques may actually retard long-term growth. His evidence and analysis questions the "inherent advantage" in borrowing advanced technology as a means for overcoming basic deficiencies in technical and managerial skills. These technologies usually rely upon a high degree of interplant dependence, tight production schedules, and rigid standards and specifications for materials and parts—all of which are generally lacking in industrializing economies.

My own case study of *Manufacturing Problems in India* (New York, 1967) reveals some of these shortcomings and constraints affecting diesel engine production in India during the early 1960s. The Indian experience in developing steel production also indicates marked difficulty (and economic loss) with the more sophisticated products and techniques during early stages of industrialization. (The success of the Bhilai plant, which was built with Russian assistance to turn out standard grades of construction steel using conventional techniques, stands in contrast to the much more sophisticated plant built at Rourkela with German assistance and designed to produce the much more complex alloy steels requiring a much more complex technology and level of managerial skills.) For infant economies, less sophisticated technologies that rely more intensively on lower levels of skills may be more appropriate. Contrary to Soviet official policy, labor-intensive techniques were widely used in assembly, materials handling, equipment maintenance, parts inspection, and in other auxiliary production activities.

The Hirschman view that "machine-paced" technology forces an upgrading of managerial capabilities in such areas as maintenance and quality control may be valid. But the question raised by Granick's interpretation of the Soviet experience is whether this does not result in inefficient capital utilization in the long run because of what Toynbee would term an "inadequate response" to an "overwhelming challenge." The Soviet experience seems to suggest that an intermediate strategy and investment role would have been more advantageous. This would imply preliminary emphasis upon labor and engineering training and the establishment of more effective administrative systems.

JACK BARANSON

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### Land Economics; Agricultural Economics; Economic Geography; Housing

*Economic Evaluation of Urban Renewal.* By JEROME ROTHENBERG. Washington, D.C.: The Brookings Institution, 1967. Pp. xiii, 277. \$6.75.

Although the federally assisted urban renewal program is almost twenty years old, it has been carried forward without significant assistance from

economists. This book helps to remedy this neglect by contributing useful insights into appropriate goals and analytical methods for evaluating renewal.

In what is essentially an expansion and updating of work largely completed in 1963 and previously published in the Brookings volume *Measuring Benefits of Government Investments* (Washington, 1965, pp. 292-366), Rothenberg examines urban renewal using a modified form of benefit-cost analysis—one which wisely allows for the consideration of redistributive effects. He confines attention primarily to one form of renewal, residential redevelopment. Although this limited focus captures significant generic aspects and has considerable analytic advantages, it results in a distorted impression of urban renewal as a whole. The majority of redevelopment to date has resulted not in residential, but in commercial, industrial, institutional, and public re-use, and emphasis in residential renewal has recently shifted to rehabilitation.

Following two introductory chapters providing a brief institutional setting and theoretical methodology, Rothenberg examines broad areas of renewal benefit. These include slum elimination, improving the competitive position of central city land uses within metropolitan areas, and strengthening central city government finances. Under his assumptions of full employment and the metropolitan area as the appropriate universe for measuring aggregate benefits, the last two are primarily redistributive. They are not analyzed in detail.

Confining his attention thereafter primarily to residential redevelopment and the accompanying slum elimination, Rothenberg develops simple theoretical impact models. These reflect aggregate income effects of internalization of externalities on land use and reduction in social costs of slums, as well as redistributive effects of changes in housing stock composition. Consequences of these three effects are then treated in more detail in separate chapters.

He next makes a crude attempt to test the theory empirically, using data for five Chicago redevelopment projects from 1956 to 1963. Rothenberg cautions that the example is "not intended as a serious empirical application of the method suggested in this work" (p. 176). That warning should be heeded. He does not, however, cite or evaluate a much more ambitious and persuasive attempt by Mao to carry out a similar empirical study, *Efficiency in Public Urban Renewal Expenditures Through Capital Budgeting* (Berkeley 1965).<sup>1</sup>

The book concludes with two chapters which somewhat broaden the focus and examine issues more relevant to current policy concerns. The first of these is essentially a useful critique of criticisms levelled at urban renewal by M. Anderson, *The Federal Bulldozer* (Cambridge 1964) and W. G. Grigsby, *Housing Markets and Public Policy* (Philadelphia 1963). The second briefly examines alternative methods of accomplishing renewal goals.

<sup>1</sup> There is a reference in the bibliography to a highly condensed summary of this study. J. C. T. Mao, "Efficiency in Public Urban Renewal Expenditures through Benefit-Cost Analysis," *Jour. Am. Inst. Planners*, March 1966, 32, 95-107.

There were several parts of the book I found particularly valuable. One is emphasis on measuring aggregate benefits in the metropolitan context (pp. 25-30). This implies development of appropriate federal criteria to constrain objectives of competitive intrametropolitan renewal efforts. Also excellent is the theoretical discussion of why slums are a suboptimal response in providing low-income housing (pp. 39-56), and the examination of the redistributional implication of redevelopment in altering housing stock composition—one which tends to affect adversely low-income families (Ch. 9). The discussion of alternatives to redevelopment—especially of residential rehabilitation and programs to assist directly central city finances (pp. 243-54)—is extremely perceptive and would have benefited from expanded treatment.

I also admit to some major reservations. The precise audience to which this book is addressed is unclear. Treatment of institutional aspects is too brief—and in places inaccurate—making it an unsatisfactory introduction for the economist unfamiliar with renewal. Rothenberg admits that the theoretical approach may be of little use to day-to-day administrators. There is, however, a suggestion that “it is intended to be relevant to the role of the broad policy maker” (p. 31). But I wonder what a Congressman will make of an often impenetrable style that produces such sentences as: “The real income level of these individuals is, strictly speaking, a vector of their well-being, but benefit-cost analysis passes beyond the injunction in Paretian welfare economics against interpersonal comparisons and aggregates the money value of real income changes across individuals” (p. 20).

More substantively, I feel Rothenberg dismisses too briefly possible renewal benefits associated with reducing unemployment and underemployment. He examines this issue solely in the context of cyclical fluctuations (pp. 137, 212-13). The problem in parts of many urban areas, however, is one of long-run slack. One explicit goal of the Model Cities program—which depends heavily on a renewal component—is just such an increase in employment opportunity.

Despite Rothenberg's disclaimer, I feel that one proposing use of benefit-cost technique bears responsibility for producing a significant application. The one carried out (Ch. 11) is so trivial and imprecise as to call into question the entire theoretical approach developed. No discount rate is employed, there is no quantitative estimate of the reduction in social costs following redevelopment, and the method of measuring land value increases is extremely cumbersome. Further, it results in estimates far exceeding the actual land disposition proceeds obtained in these projects. Rothenberg admits “it is indeed possible that the benefits from using benefit-cost analysis may not be worth their cost” (p. 258). He does nothing operational to disprove this hypothesis.

This is a book worth selective reading for approaches to a conceptual framework, but it is not, in my opinion, a full economic evaluation of the complex dimensions of urban renewal.

JOHN D. HEINBERG

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*Economic Aspects of Oil Conservation Regulation.* By WALLACE F. LOVEJOY AND PAUL T. HOMAN. Published for Resources for the Future, Inc. Baltimore: The Johns Hopkins Press, 1967. Pp. xii, 295. \$8.50.

Despite its title, this treatise does not confine itself to the "economic" aspects of oil conservation regulation. Nor is it a fundamental contribution to the economic analysis of conservation. Perhaps its central message is best described as an attempt to mediate between economics and the melange of politics, business institutions, vested interests, laws, and engineering practices that make up "conservation" as the petroleum industry sees it. The book's outstanding virtue is its unusual wealth of institutional detail, enriched with insight into the extraordinary complexity of the practices and interests in the industry and their deep historical roots. The authors have clearly gone to great pains to develop the facts and to understand and evaluate the points of view of the various segments of the industry and its many regulators.

A corresponding drawback is that the economic analysis suffers from looseness of construction, ambiguity, and fragmentation. The authors say early in the volume that they will not be slaves to definitions (p. 10); yet economic analysis does require rigorous definitions, among other things, for meaningful discourse. They note that economic analysis of oil conservation is the "... application of the general theory of economizing to the special circumstances and institutions that go to make up the domestic oil industry." But the reader will not find any such general theory in the book. It does use an application model devised by Stephen L. McDonald, defining optimum production over time from a given oil reservoir. This is helpful, but it might have been put to better use. An analytical critique of present policy in terms of such a model, or extensions of it, would help to orient the reader in the highly diverse institutional environment of oil production and conservation.

Moreover, the positions taken by the authors on oil conservation policy do not seem to rest entirely on economic considerations, even though the final statements of policy declare in favor of economic efficiency. It is not clear how other norms should enter into a compromise policy, in their view. Unfortunately it is not possible to get all of the vested interests and practices into the same tent with economic efficiency without producing confusion. The task of the economist is to offer the contribution of his discipline to analysis and evaluation of policy, not to attempt to wear the hats of all interested parties. Economic analysis in this book is often obscured by such considerations.

The statement of policy in the final "summary review," however, is both clear and emphatic. It identifies (pp. 265-66),

four interrelated, but separable, sources that define the nature of the industry's inefficiency and underlie its basic problems. These are (1) excessive capital investment, (2) excessive producing capacity, (3) inefficient reservoir development, and (4) proration rules that favor the production of high-cost oil.

These problems are caused in turn by overdrilling induced by existing proration formulas, less-than-effective control of well spacing, a production con-

trol system which gives priority to vested interests and political considerations rather than to economic efficiency, and imperfect cartelization of the industry for the purpose of stabilizing prices. Many other economists have made the same observations. The real question for policy is how to overcome these problems and move the industry closer to an economic optimum. The authors rightly caution their fellow economists that the industry cannot be transformed overnight, that certain effects of past policies are irremovably built into the present situation, that we have to start from where we are, etc., but they agree with other students of the industry in calling for a transition toward a more efficient economic organization of the industry. Whatever will speed up that transition is an appropriate avenue for public policy. Readers of this book will have a good picture of both the opportunities and the problems for conservation policy.

JAMES W. McKIE

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*French and EEC Grain Policies and Their Price Effects, 1920-1970.* By HELEN C. FARNSWORTH AND KAREN J. FRIEDMANN. Food Research Institute Studies, Vol. VII, No. 1. Stanford, Calif.: Food Research Institute, 1967. Pp. 140, A-18. \$2.50.

This comprehensive, scholarly and well-documented study is divided into two parts, (1) French Grain Policies and Programs, and (2) Influence of Government Intervention on French Grain Price. The sequence of subject matter is partially chronological, proceeding from the mid-'twenties when France was a net importer of wheat and from the years immediately following when domestic grain production expanded.

The discussion rapidly proceeds to the inauguration of the EEC grain policy and at that point becomes largely functional. However, the functional arrangement is sometimes difficult and the duplication of subject-matter treatment disturbing. For instance, Part I has a chapter on French Grain Policies and Controls Under EEC Regulations and Part II has a parallel chapter on Changes in French Pricing and "Protection" of Grains Under EEC Transitional Regulations, 1962-67 and Outlook. Thus, the absence of an index is particularly regrettable. Another presentational shortcoming is the uninviting, small scale of the charts. An introductory reference to the senior author's study, *Determinants of French Grain Production, Past and Prospective*<sup>1</sup> would have answered some questions.

The authors have succeeded in creating an understanding of (1) the cumbersome rigidities of French grain programs preceding the EEC Common Agricultural Policy and (2) the present levy system. The latter, in spite of its baffling complexities, might be considered simple in comparison with the preceding program, the more so since the present EEC-wide program supersedes six complex programs, one for each member country. French grain prices were uniform throughout the country until 1962 when the transitional EEC grain regulation introduced regional price differentiation.

<sup>1</sup> Food Research Institute Studies, Vol. IV, No. 3, Stanford, Calif., 1964, pp. 225-72.

EEC programs to minimize or discourage actual government takeover in the course of agricultural price support are more cumbersome than comparable measures in the United States. Here a farmer can obtain a CCC price-support loan, pay it off later, resume title to his crop, and sell it for his own account. In the EEC countries, price "intervention" constitutes an irreversible sale. To minimize "intervention," the French have a "Type B" price-support program, which allows selling to ONIC, the semi-official French price-support agency, at a higher price than the EEC support price. They also permit the price-support agency to strengthen the market price level by withdrawing or withholding supplies from the market. This resembles the policy under U.S. fruit and vegetable marketing orders and agreements.

Past French policy exempting small producers from the assessment for export sales ("quantum tax") resulted in a higher price to small growers than to larger and more efficient ones. This price discrimination was abolished when the unified Common Agricultural Policy for grains became effective on July 1, 1967. Thus, large growers who had borne the burden of the assessment for export sales, now shifted to the European Guidance and Guarantee Fund, came in for enjoyment of a significant price increase. Small growers, however, gained less from the new Policy.

The authors also question the realism of location differentials used by the EEC for determining the "low c.i.f." price. They observe that "the Commission's experts have to approximate the Rotterdam price equivalent of a host of differently priced c.i.f. offers to numerous market destinations in various parts of the world." In practice, however, the Rotterdam c.i.f. price is almost always the decisive one—once in a very great while Hamburg may be considered.

Although the study's heading refers to 1970, it contains no projections but merely analyzes the forces and policies now at work and shaping the immediate future. The "Summary View of 1920-1970," at the end of the study, mentions the authors' expectation that wheat producers' prices will average about 15 per cent higher in 1967/68 than in 1964-67; and will rise almost 20 per cent for many of the larger producers. Barley producers are also expected to obtain a price increase of about 20 per cent. However, the seemingly crucial observation, "In view of France's large agricultural resources and past developments, these planned prices seem certain to stimulate production of both grain and livestock products, with wheat and barley apparently favored most by the new price-cost structure," remains buried in the study and, amazingly, is not mentioned in the Summary View.

A major analytical conclusion of the authors is that "improved estimates of national margins of support offer a much more promising basis for comparison of the protective effects of widely differing national grain programs than does any measure now in common use."

As to future developments, the authors conclude that the willingness of Community leaders to bind and perhaps later reduce existing margins of support on major agricultural products is a most constructive proposal. Yet, at the very end the authors recognize the threat of further increases in EEC

grain target prices. Unfortunately, toward the end of 1967 the Community moved in the latter direction by raising the feed grain price level for 1968.

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### Labor Economics

*Labor in the South.* By F. RAY MARSHALL. Cambridge: Harvard University Press, 1967. Pp. xiv, 406. \$8.00.

*The Advancing South: Manpower Prospects and Problems.* By JAMES G. MADDOX WITH E. E. LIEBHAFSKY, V. W. HENDERSON AND H. M. HAMLIN. New York: The Twentieth Century Fund, 1967. Pp. xvi, 276. \$6.50.

Marshall's contribution is the latest addition to the Wertheim Publications in Industrial Relations. In the foreword, John T. Dunlop notes that this work fills a void in the history of the American labor movement, and he concludes that "This volume will long remain a standard work." The unusual combination of talents and interests displayed by Marshall and the nature of the book support Dunlop's observation.

Marshall brings many attributes to his task as chronicler of labor history in the American South. He is widely read in history, has an abiding interest in the growth of collective bargaining, and has written more on the relationship between unions and the race question than any other academic economist in the United States. In addition, Marshall has enjoyed a close working relationship with many of the union officials who were personally involved in the long struggles described in this book—this experience gives his work a flavor that could not be duplicated by his more cloistered colleagues.

The book is divided into five parts: (1) Institutional Setting and General Development, (2) Development of Unions by Trade and Industry before 1932, (3) The Depression and the New Deal, (4) War and Postwar Development, and (5) Union Growth in the South: Status, Causes, and Prospects. Within the three central parts Marshall presents case histories of union developments in several trades and industries: printing, building, rails, longshoring, coal, textiles, agriculture, paper, and lumber. In each case he has a section covering the influence of race relations in the industry or trade and the effects of such relationships on organizing drives and the operation of locals and the state federations.

The central theme of the book, of course, is the fight for union organization. In his preface, Marshall makes it clear that Southern soil historically has not been conducive to union growth: "The unity of white managers and workers, the race problem, the surplus of labor in a low-income agriculture, the nature and composition of southern industry, the undemocratic political tradition, the idea that industrialists were benefactors, all created relatively unfavorable conditions for the growth of unions." Against these imposing barriers Marshall can only muster two things favoring union growth: a desire on the part of



Southern workers to have some say in their working conditions and assistance in this matter from their unionized non-Southern brothers who wish to protect standards negotiated elsewhere. Hence, it is no surprise that the South lagged behind the other sections of the country in the organization of its nonagricultural workers. Marshall reports that the South has closed the gap a bit since 1939; and he suggests that the changing composition of industry, which makes it easier to organize branches of firms that are organized outside of the South, along with some softening of the hard line against unionism, especially in the larger metropolitan areas and in the Southwest, augur for a somewhat easier, though still difficult, time for union organizers. In 1964 some 14 per cent of the South's nonagricultural work force was organized—the comparable national figure was 30 per cent. Marshall concludes that the gap between the South and the nation will be narrowed, but that organization will grow more slowly than the positive change in the size of the nonagricultural labor force in the South.

The emphasis on union organization determines the focus of Marshall's interests in the race question, and he concludes that changes in race relationships have diminished the deterrent once imposed by these antagonisms, though another set of problems has come in the wake of this development. Marshall compares the pre-World War II period with that subsequent to the 1954 desegregation decision of the Supreme Court, and writes that ". . . the basic nature of the 'race problem' had changed from a question of whether or not to organize Negroes—which is still a problem in some unions . . . to opposition to the equalitarian racial policies of the entire labor movement and equal treatment of Negroes already in the unions" (p. 311). Many observers, including this reviewer, would question the existence of the equalitarianism "of the entire labor movement," but still agree that the race issue is much less divisive these days in organizational drives and that the arena of controversy is now being transferred to equal treatment of all union members.

A labor history that covers so many industries and so many states as well as numerous issues was not easy to write. In places one finds real excitement in the stories, but in others the prose is heavy and one can predict that few will read this volume straight through. Still, as observed earlier, it "will long remain a standard work."

*The Advancing South: Manpower Prospects and Problems* is the result of an interest by the directors of the Twentieth Century Fund in the composition and impact of recent economic growth in the American South. The authors reason that the South should be treated as an underdeveloped country, cast their study in a manpower context, and emphasize the relationship between economic change and problems and prospects for Negroes.

An examination of the history of the South and underdeveloped countries led the authors "to the hypothesis that the major explanations for the South's low incomes and general economic backwardness are essentially the same as those applicable to many underdeveloped national economies" (p. 5). In their review of the literature on economic development the authors were impressed by the emphasis placed on "three forces in generating . . . growth . . . first, increases in the supply of traditional factors of production . . . second,

changes in the organizational structure of the economy . . . third, improvements in technology . . ." (p. 5). Further, they noted that successful countries had emphasized changes in organization and improvements in technique, hence the authors single out such changes that have occurred recently in the South and stress these factors in the recommendations that conclude the book.

The manpower emphasis is concentrated on the recent past and the immediate future. A major portion of the book is devoted to dissecting the changes in employment by industry in the South and in the nation in the period from 1940 through 1960. Further, the authors make a manpower projection for the South and the nation for 1975. Some 40 pages of appendices provide the basis for the manpower comparisons and projections. From this concentration on employment data in an industry-mix context the authors make several observations, most of these concern the differences in rates of growth and decline between the nation and the South. They conclude that the South is changing and diversifying in a manner that suggests it is coming to resemble the rest of the country. However, they also point out that continued diversification and growth will rest on improved economic organization and advancement in technique. In order to achieve these lofty aims the South must improve the quality of its labor force, but "a major obstacle to the South's economic development is . . . its educational system, particularly for Negroes" (p. 79).

In a lengthy chapter entitled "Education and Southern Economic Development" the general theme is that the educational system is turning out a better product (the authors, like a growing number of economists, look at the educational system in these input-output terms) for both Negroes and whites, but see little evidence that the gap between Southern and national quality will be very much narrowed in the foreseeable future. The point is also made that Southern states spend a higher portion of their incomes on education, but they still lag behind the rest of the country in expenditure per pupil.

The material dealing with the employment prospects of Southern Negroes is an updating of the familiar, often-told, depressing story. The authors observe that the educational gap between whites and Negroes will be narrowed in the South, but argue that historically tight labor markets have been the best avenues to increased employment opportunities and they see little reason to expect that the future will be much different.

The book concludes with a plea for federal income transfers. Although the authors do not mention the Heller Plan, they reason that the Southern educational apparatus should receive a sizable infusion of federal money if the aim of growth, as they define it, is to be achieved.

This book was not intended to be, nor is it, a contribution to our knowledge in the three disciplines that underlie the study: economic development, manpower studies, and regional science. One can agree with their observations concerning the state of education, but still come away from the book with an uneasy feeling. The authors point out that the South is coming to resemble the rest of the country, yet this work completely neglects the probability that Southern cities will be beset with the same types of problems that now con-

front our Northern cities: congestion, central city deterioration, de facto segregation, smog and so on. Anyone can argue, and everyone does, that certain things are beyond the scope of his study; but the quality of life in American cities is the problem of our times.

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### Population; Welfare Programs; Consumer Economics

*Medicare and the Hospitals: Issues and Prospects.* By H. M. SOMERS AND A. R. SOMERS. Washington: The Brookings Institution, 1967. Pp. xvi, 303. \$6.75.

This volume represents another contribution by the Somerses to the growing literature on various aspects of the organization, structure, and distribution of health and medical care services in the United States.

This book is an analysis of the medical care system centered around the hospital. The recent passage of the Medicare legislation is viewed by the authors as an evolutionary culmination of a number of previous trends which serves to crystallize and bring into focus many areas of political and technical development of the medical care system. This situation is likely to place a higher premium on solution of many problems which, up until now, have not been directly confronted. The legislation is the stimulus and the hospital is the institution of primary concern although the authors acknowledge that the legislation extends beyond the hospital system alone. This represents an appropriate constraint on a topic sufficiently complex in its reduced form.

The book is divided into three sections, the first of which describes the political process leading up to the development of the Medicare legislation, the mechanics and administration of the legislation itself, and establishes the context of the contemporary hospital in the overall medical care setting. The second major section of the book attempts to deal with a number of issues, each of which has been the object of considerable interest, discussion, debate and dispute. Under the heading of each of these, the Somerses have managed to present in a relatively concise manner much of the diversity of fact and opinion which is known. Although the Somerses are not without willingness to espouse their own opinions, the primary attribute of these chapters is that they represent a comprehensive analysis of what is at issue in each area and the implications of the Medicare legislation for these issues. In fact, the legislation was shaped in response to presumptions, not always explicitly acknowledged, of the validity of each argument. The menu of issues omits little of consequence in the field of medical care: the adequacy of facilities, the quality issue, the manpower crisis, hospital-specialist relations, how hospitals should be paid, hospital planning, and how costs can be contained.

The book then concludes with a section which presents the authors' views of the prospects for the future, both of the legislation itself and for the hospital as an institution. Appendices include a summary of the Medicare provisions.

This is not a book of economic analysis although many of the observations embody considerable economics. However, it is clear that this book is likely to serve, as the authors' previous one, the considerable need for a coherent, comprehensive discussion of the institutions and their interaction with the economic setting of medical care activities in society. For example, the relationship of hospital costs to reimbursement structures and the relationship of both to consumer behavior is presented clearly and fully. This volume is primarily descriptive rather than analytic, a circumstance which hardly represents a deficiency. It is evident that the inadequacy of much economic analysis applied to medical care has usually stemmed from inadequate understanding of the complexity of the problems being evaluated rather than any deficiency in the analytic constructs.

Since the publication of the earlier book, *Doctors, Patients and Health Insurance*, those of us with responsibility for teaching students in economics with an interest in health as well as people interested in the area of health and medical care but not specifically knowledgeable about it, have found themselves more and more relying on the Somerses as a first exposure. Such an exposure serves a number of purposes for which the current book is equally admirably suited. Like all such subjects, medical care issues often revolve around institutions and concepts that are unique. Much of the discussion of prepayment and insurance, group practice, service benefits, indemnity benefits, etc., requires the acquisition of a vocabulary and understanding of issues beyond what might fall into most individual's experience. The current book will serve to provide a giant step forward for the interested reader with respect to understanding of both the relationships among the issues raised and of the degree to which potential solutions have been incorporated into current discussion.

Much of this contribution is a reflection of the high degree to which Professor and Mrs. Somers have been able to incorporate into their discussions of issues—such as, how hospitals should be paid, the containment of costs, and the adequacy of facilities—almost the entire range of ideas that have been originated, argued, and defended over the past decade. The presentation is often subtle and always descriptive and intuitive, but those of us who have followed this area will find little missing or out of context. It is difficult to fault a book which provides such an informational and descriptive step forward.

The major reservations about the book relate to the authors' views of the appropriate solutions and the evaluation of procedures, particularly those leading up to the passage of the legislation. It seems to this reviewer that too much of what was known to be inefficient and even organizationally misdirected tends to be viewed as "perhaps" the inevitable and necessary steps in the process of change of our medical care structure. Such an approach leaves one with the feeling that the political rationalization may prevent our learning the most useful lesson that, often, the long-run price for short-run acceptance of a "principle" turns out to be excessively high.

One could rank the potential functions of the book as to areas in which it is most helpful. This is a superb description of a very complicated and complex process which provided considerable enlightenment to this reviewer in spite of

his familiarity with the field. On that criterion, one has to give the book many stars. The suggestions and recommendations for the future lack the clarity and specificity for which one might have hoped. Their look to the future lacks the sure hand of their discussion of the issues—and, for this reviewer, is somewhat anticlimatic.

The highly contemporary nature of this book and the degree to which it has incorporated a lot of what was, only a few years ago, unheard-of arguments, discussions, and viewpoints is a mark of the skill of the Somerses and perhaps the primary contribution of this volume. For the specific task set out by the Somerses, using a discussion of the development of Medicare and relating this to its role in the development of a radically and rapidly changing medical care system in the United States, they have done an admirable job. I have already recommended this book to a number of students. In some sense it represents a considerable improvement over their earlier volume, primarily in terms of their more extensive discussion of the “nitty-gritty” issues. Whether this reflects the degree to which they have learned more in the past seven or eight years or whether it represents their view of what the rest of us are ready for, I, for one, am grateful for the incremental exposure. Without doubt this should prove to be a useful and widely read volume, and represent a contribution to the “core knowledge” on which economists, if we are to make some substantial contribution to the solution of the problems so well presented here, can then build to provide effective and fruitful analyses.

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*A Decade of Health Services: Social Survey Trends in Use and Expenditure.*

By RONALD ANDERSEN AND ODIN W. ANDERSON. Chicago and London: University of Chicago Press, 1967. Pp. xix, 244. \$13.00.

The authors present an analytical study of recent trends in the United States in consumer use and expenditure patterns for medical care and health insurance as revealed by 1953, 1958, and 1963 survey data. The volume is the third in a series by Odin Anderson.<sup>1</sup>

Although the economic environment changed considerably over this ten-year period of rapid growth of the health care industry, now the third largest in the United States, the data used are comparable. Some criticism might be raised on reliance on the interview method, but the authors have carefully cross-checked their interview results against the records of hospitals, employers, and insurance companies.

During the ten-year period 1953-1963, there was a 70 per cent increase in mean expenditure for health services. The authors estimate that about 42 per cent of this increase was due to increase in “price” and the remainder to increase in “use.” They also note that the relative importance of increases in “use” and “price” varied according to type of service: for hospitals “90 per

<sup>1</sup> O. W. Anderson and J. J. Feldman, *Family Medical Costs and Voluntary Health Insurance*, New York 1956, and O. W. Anderson, P. Collette and J. J. Feldman, *Changes in Family Medical Care Expenditures*, Cambridge, Mass., 1963.

cent price, 17 per cent use" and "for drugs, with use accounting for a 110 per cent increase and price only 9 per cent" (p. 123 and footnote for method). During the ten-year period the increase in costs and use were accompanied by great technological advances in medicine and rapid growth in private health insurance.

Probably the most significant data in the book are:

... in each study over the decade expenditures of insured families have been greater than expenditures of uninsured families. In 1953 the mean expenditure for the uninsured families was \$154 compared to \$237 for the insured. By 1963 the corresponding amounts were \$201 and \$429. Large differences between insured and uninsured families are also found when median expenditures are considered.

Through the decade expenditures for insured families have been growing faster than expenditures for the uninsured. In 1953 mean expenditure for the uninsured families was 64 per cent of mean expenditure for the insured. By 1958 this percentage had dropped to 57 per cent and further declined to 47 per cent in 1963.

... that the expenditure of insured families is higher at every income level ...

Insured families spend more in absolute amounts than do uninsured families, and they also spend a larger percentage of their income on health (p. 136).

Although some correction may be warranted as for uninsured receiving greater amounts of free care, the above relationships still hold.

Not all the wealth of data presented by the authors can be commented on. I would like to consider first some of the data on voluntary health insurance and, secondly, data relative to the supply and demand in medical care markets.

In general, the authors' findings substantiate those of the Health Insurance Association and Blue Cross and Blue Shield in that they portray rapid growth in health insurance coverage and show that group insurance provides more comprehensive benefits than individual insurance. A major value of the study, however, is that it goes behind the averages and summary figures. For example, the authors note that *re* private health insurance "The increase since 1958 has been primarily among families formerly least likely to be covered, such as those with low incomes, rural-farm residents or where the head of the family is old" (p. 83), and further that "The percentage of persons covered in the 55-64 age bracket increased from 63 to 72. An even larger increase—from 43 per cent to 56 per cent—occurred in the 65 and over age group. Gains among other age groups between 1958 and 1963 were small" (pp. 82-83). Although the advent of Medicare has probably halted this area of expansion of private health insurance coverage, its historical significance is clear.

The study adds to existing data on the rapid increase in major medical care coverage. "Over three times as many families had major medical insurance in 1963 as five years earlier. These gains were mostly among upper-income, urban

families" (p. 83). Analyses of the data show that individuals who already had hospital and surgical insurance were the individuals most likely to obtain major medical care.

The data also show for the period discussed that those "families with unusually high cost for health services in a given year have benefitted most by the recent increases in health insurance reimbursements" (p. 91). In respect to hospital care alone in 1963, two-thirds of all insured families received benefits that paid 80 per cent or more of their bill. The authors state that "It is of particular interest that in both studies insurance carried by the low-income families appears at first glance to be more 'adequate' than that carried by upper income families" (p. 98). This is largely true because low-income families use less dental care, preventive medical care and other health services which are generally not covered by health insurance and thus relatively more of those services which are—hospital and surgical care. In addition, upper-income families use more expensive private rooms (the expense above semiprivate room charges is generally not covered) and are treated more often by specialists who have fees higher than the insurance may provide for or possibly who charge higher fees to higher-income persons.

In respect to the supply and demand in the health care market, the authors come up with many relatively unrelated facts which, in a study in depth of structure of medical care markets, may have great significance. Several of these are listed below.

1. Thirty-one per cent of consumers use a specialist as a regular source of medical care, 11 per cent a clinic and only 41 per cent a general practitioner. (20 per cent of nonwhites named a clinic, while only 9 per cent of whites did.)

2. Eighty-two per cent of consumers had a physical examination during the past five years, 10 per cent never had a physical examination. 53 per cent had a physical during the last year.

3. Of those reporting some physical examination, 29 per cent had a "preventive" examination, 32 per cent a required (for schools, jobs, etc.) examination, and 39 per cent one in response to symptoms. 54 per cent of all examinations of children were "preventive."

4. In 1963, in 1/10 of visits (excluding telephone calls) to physician offices, the patient was seen not by a physician but only by a nurse. (Could this partially account for U.S. relatively high reported physician visits per capita per year?)

5. Although there was no trend change in the number of physician visits, home visits decreased from 11 per cent in 1958 to 5 per cent in 1963.

6. In 1963, over 50 per cent of hospitalized surgery was performed by nonsurgically trained physicians; that is, only 46 per cent was performed by Board certified specialists, which, however, was a decided improvement over the 37 per cent rate in 1953.

7. The survey data for 1963 state that 100 per cent of births were attended by a physician and 99 per cent were delivered in a hospital. Although to this reviewer these percentages appear somewhat high in view of the higher death rate at birth in low-income rural areas, the item is footnoted as follows:

<sup>27</sup> "Similar data from the National Health Survey are found in National Center for Health Statistics, 'Natality Statistics Analysis, United States, 1963,' ser. 21, no. 8 (March, 1966)." The latter's data are 98.2 per cent attended by physicians and 97.4 per cent hospitalized. It is possible that there is a refusal bias in any interview data of this nature in underrepresentation of illegitimate births. In view of recent Administration recommendations more statistical information would be welcome.

8. In 1963, 96 per cent of pregnant women saw an M.D. by the end of the sixth month, and 80 per cent had by the end of the third month. Differences by income level in respect to prenatal visits and length of hospital stay had definitely narrowed between 1953 and 1963.

9. Ten per cent of all with major illnesses received substantial amounts of free care and half of these because they were unable to pay for it.

Although the study has many more interesting data of this general nature, some confirming for example the interrelations between low income and poor health, the above I believe to be the more unique data presented.

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*The Doctor Shortage—An Economic Diagnosis.* By RASHI FEIN. Washington: The Brookings Institution, 1967. Pp. xi, 199. \$6.00.

Persistent public concern with the "doctor shortage" in the United States is reflected in thousands of pages of Congressional testimony, at least four major studies by government commissions, and countless articles in the popular press. For the most part the discussion of the shortage of physicians' services has been in terms of physician-population ratios, with policy prescriptions aimed at maintaining national ratios achieved in some base period, or bringing various regions up to the national average or up to the ratio achieved by a region with a "relatively good" supply of health facilities. Unfortunately the prolonged debate has been carried on without the benefit of an economic framework. Fein's book admirably fills that gap.

The core of Fein's volume is a projection of the demand for physician visits and the supply of doctors for the years 1975 and 1980. His demand projections "assume that persons with given characteristics in 1975 and 1980 will visit physicians as often as persons with those same characteristics visit physicians today." Using National Health Survey utilization data ("physician visits per person per year") and Bureau of the Census population projections, he analyzes the impact on demand of eight demographic and socio-economic factors: population growth, age and sex distribution, urbanization, regional migration, color, education, income, and Medicare. Fein's estimates indicate that the demand for physician visits will increase between 22 and 26 per cent by 1975 and between 35 and 40 per cent by 1980. The projected increases in demand, Fein emphasizes, are minimum estimates; other pressures—changes in technology, in the public's taste for medical services, and in government



programs to assist those who are unable to finance "sufficient" care—while not readily quantifiable, may add significantly to demand.

On the supply side, Fein estimates that the 305,000 physicians in 1965 will increase to 362,000 by 1975, a growth of 19 per cent and 3 to 7 per cent short of the minimum projected demand; by 1980 the estimated shortage will be between 5 and 10 per cent. To fill the gap created by the projected growths in demand and supply, he suggests the possibilities of stimulating productivity by expanding group practice and by the use of new types of medical personnel.

He presents, largely on a priori grounds, the standard case for group practice: (1) economies of scale of larger organizational units; (2) optimal ratios of physicians to other personnel and capital equipment; (3) a reduction in unnecessary hospitalization often associated with present insurance mechanisms; (4) a more efficient use of personnel to enable a savings of physicians' time.

New types of personnel, Fein suggests, may "relieve the physician of those tasks not requiring the long period of education and training that characterizes medicine in the United States." The enormous growth in the numbers of paramedical personnel lends historical support to his argument. Furthermore, there may be a significant malallocation of resources in the "overtraining" of medical specialists. In pediatrics, for example, as Dr. Herbert Ratner has observed, ". . . the pediatrician who was trained extensively to take care of . . . very serious illnesses ends up spending most of his time parading a series of well babies through an assembly line setup." Paramedical personnel, including "sub-physicians" or "assistant physicians," as suggested by Fein, could reduce such waste.

Fein's policy prescriptions concentrate on efforts at raising productivity and question the position commonly taken by government commissions and medical educators (and belatedly accepted by the American Medical Association!) which emphasizes increasing the number of physicians. To achieve his productivity goals, the author suggests that support from the federal government and medical educators will be needed for training and employing new personnel and for the development of group practice and alternate organizational forms that take advantage of possible economies of scale.

Several criticisms may be made of Fein's policy recommendations: (1) His concern with fostering increased productivity to fill the predicted gap in medical services seems excessive in the light of data he himself cites. These data (p. 137, footnote 12) indicate that productivity increases in medicine between 1949 and 1959 were substantially greater than would be needed to fill the relatively small predicted gap. (2) His analysis attempts to measure the gap between the projected *growth* in demand and the projected *growth* in supply but does not tell us whether there is currently a shortage. If there is a current shortage (enormous increases in the relative income of physicians, and other data, have convinced this reviewer that the shortage is substantial), then Fein's recommendations for filling the gap he projects may do no more than perpetuate existing shortages. (3) The development of new personnel and new forms of organization is less a problem of achieving the financial support of

foundations and government, as Fein suggests, than it is of breaking down the powerful resistance of organized medicine. Although he devotes about twenty pages of his text to group practice, and suggests its expansion as a major policy measure, when he discusses the conditions which make it difficult for physicians to join groups, he does not mention the bitter opposition to group practice, particularly prepaid group practice, by the A.M.A. and its constituent societies.

These criticisms are minor when weighed against Fein's achievement. In the process of developing his economic framework for discussing the doctor shortage, he makes many suggestive comments and wise observations which should stimulate research and should be helpful to those in policy-making positions. He states that his study is "designed to raise questions, illuminate areas, and offer policy implications." Fein's book is a success on all three counts.

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# NOTES

## EIGHTY-FIRST ANNUAL MEETING OF THE AMERICAN ECONOMIC ASSOCIATION

Pick-Congress Hotel, Chicago, Illinois, December 27-30, 1968

### *Preliminary Announcement of the Program*

*Friday, December 27, 1968*

12:30 P.M. EXECUTIVE COMMITTEE MEETING

*Saturday, December 28, 1968*

8:30 A.M. THE SUPPLY FUNCTION IN AGRICULTURE, REVISITED (Joint session with the American Farm Economic Association)

*Chairman:* GLENN L. JOHNSON, Michigan State University

*Papers:* The Representative Farm Approach to Estimation of Supply Response  
JERRY A. SHARPLES, Economic Research Service, U.S. Department  
of Agriculture

Positivistic Measures of Aggregate Supply Elasticities: Some New  
Approaches

LUTHER G. TWEETEN AND LEROY QUANCE, Oklahoma State  
University

*Discussants:* MARVIN W. KOTTKE, University of Connecticut

W. NEILL SCHALLER, Economic Research Service, U. S. Depart-  
ment of Agriculture

JAMES H. WHITE, University of Arkansas

8:30 A.M. TRANSPORTATION AND THE PUBLIC UTILITIES (Joint session with the Transpor-  
tation and Utilities Group)

*Chairman:* CHARLES A. TAFF, University of Maryland

*Papers:* Transport Regulation and Economic Efficiency

MARTIN T. FARRIS, Arizona State University

Congestion Theory and Transport Investment

WILLIAM S. VICKREY, Columbia University

Transportation and Price Stability

GEORGE W. WILSON, Indiana University

*Discussants:* DONALD V. HARPER, University of Minnesota

JOHN L. HAZARD, Michigan State University

JOSEPH V. YANCE, Boston University

10:30 A.M. WAGE-PRICE DYNAMICS, INFLATION AND UNEMPLOYMENT

*Chairman:* ALMARIN PHILLIPS, University of Pennsylvania

*Papers:* The Phillips Curve and the Distribution of Unemployment

G. C. ARCEIBALD, University of Essex

How Can the Phillips Curve be Moved to Reduce Both Inflation and  
Unemployment?

CHARLES C. HOLT, University of Wisconsin

Economics of the Absent Escalator

EDMUND S. PHELPS, University of Pennsylvania

*Discussants:* FRANK BRECHLING, Northwestern University

OTTO ECKSTEIN, Harvard University

RICHARD A. LESTER, Princeton University

- 10:30 A.M. **PROBLEMS IN THE THEORY OF PUBLIC CHOICE** (Joint Session with the Public Choice Society)  
*Chairman:* JAMES M. BUCHANAN, University of California, Los Angeles  
*Papers:* Social Costs and Governmental Action  
 GORDON TULLOCK, Virginia Polytechnic Institute  
 An Economic Theory of Social Movements  
 ALBERT BRETON, London School of Economics and  
 RAYMOND BRETON, Johns Hopkins University  
 Lewis Carroll and the Theory of Games  
 DUNCAN BLACK, University of Wales and University of Chicago  
*Discussants:* THOMAS BORCHERING, University of Washington  
 ALLAN SCHMID, Michigan State University  
 BENJAMIN WARD, University of California, Berkeley
- 10:30 A.M. **MICRO-DEVELOPMENT: THE TRANSFORMATION OF VILLAGE-LEVEL ECONOMIES**  
 (Joint session with the Association For Comparative Economics)  
*Chairman:* GEORGE DALTON, Northwestern University  
*Papers:* The Economics of Micro-Development: The Peasant in Subsistence Village Economies  
 CLIFTON R. WHARTON, JR., Agricultural Development Council, New York  
 Labor Supply in the Russian Peasant Household before Collectivization  
 BARNEY SCHWALBERG, Brandeis University  
*Discussant:* JOHN Q. ADAMS, University of Maryland
- 2:30 P.M. **THEORY OF INNOVATION** (Joint session with the Econometric Society)  
*Chairman:* EDMUND S. PHELPS, University of Pennsylvania  
*Papers:* The Sources of Productivity Change  
 WILLIAM D. NORDHAUS, Yale University  
 The Theory of Technological Progress: Production and Transmission of Knowledge  
 KENNETH J. ARROW, Harvard University  
 Technological Progress and Micro-Economic Theory  
 WERNER Z. HIRSCH, University of California, Los Angeles  
*Summary and Further Comments:*  
 EYSEY D. DOMAR, Massachusetts Institute of Technology  
 JOSEPH E. STIGLITZ, Yale University
- 2:30 P.M. **ECONOMIC DEVELOPMENT**  
*Chairman:* ARNOLD C. HARBERGER, University of Chicago  
*Papers:* Economic Development in Historical Perspective  
 JOHN C. H. FEI, Cornell University, and  
 GUSTAV RANIS, Yale University  
 The Content of Development Economics  
 LLOYD G. REYNOLDS, Yale University  
 Instruments and Goals in Economic Development—An Econometric Analysis  
 IRMA ADELMAN, Northwestern University  
 MARSHA GEIER, Yale University, and  
 CYNTHIA T. MORRIS, American University  
*Discussants:* ROBERT E. BALDWIN, University of Wisconsin  
 CARLOS F. DIAZ-ALEJANDRO, University of Minnesota  
 CHARLES R. FRANK, Princeton University
- 2:30 P.M. **THE EFFICIENCY OF EDUCATION IN ECONOMICS** (Committee on Economic Education of the AEA)  
*Chairman:* ROBERT A. GORDON, University of California, Berkeley  
*Papers:* On the Efficiency of Programmed Learning in Economics  
 RICHARD ATTIEYEH, University of California, San Diego  
 G. L. BACH AND KEITH G. LUMSDEN, Stanford University



Performance on the New Test of Understanding in College Economics  
 RENDIGS FELS, Vanderbilt University, and  
 ARTHUR WELSH, Joint Council on Economic Education  
 DEEP: Strengthening Economics in the Schools  
 JOHN E. MAHER, Joint Council on Economic Education and  
 State University of New York

*Discussants:* LLOYD G. REYNOLDS, Yale University  
 PETER O. STEINER, University of Wisconsin  
 CAREY C. THOMPSON, University of Texas

8:00 P.M. RICHARD T. ELY LECTURE

*Chairman:* WASSILY LEONTIEF, Harvard University  
*Speaker:* ALEXANDER GERSCHENKRON, Harvard University

*Sunday, December 29, 1968*

8:30 A.M. PROBLEMS IN THE AREA OF POVERTY

*Chairman:* MANCUR OLSON, JR., Department of Health, Education, and  
 Welfare

*Papers:* The OBE Size Distribution Series: Methods and Tentative Results  
 for 1964

EDWARD C. BUDD, Pennsylvania State University, and  
 DANIEL B. RADNER, Office of Business Economics  
 Alternative Measures of Economic Status and Their Correlates  
 JAMES N. MORGAN, University of Michigan and Survey Research  
 Center, and  
 JAMES D. SMITH, Pennsylvania State University and Office of  
 Economic Opportunity

Graduated Work Incentives: An Experiment in Negative Taxation  
 HAROLD W. WATTS, University of Wisconsin

*Discussants:* CHRISTOPHER GREEN, North Carolina State University  
 HAROLD W. GUTHRIE, University of Illinois  
 LESTER C. THUROW, Massachusetts Institute of Technology

8:30 A.M. OMICRON DELTA EPSILON (Honor Society in Economics)

(Selected graduate student papers)

10:30 A.M. MONETARY THEORY

*Chairman:* JOHN G. GURLEY, Stanford University

*Papers:* The Time Pattern of Monetary Effects on Interest Rates and Income

PHILIP D. CAGAN, Columbia University

Does Money Make any Real Difference?

JAMES TOBIN, Yale University

Econometric Evaluation of the Effects of Monetary and Fiscal  
 Policies

ALBERT K. ANDO, University of Pennsylvania, and  
 FRANCO MODIGLIANI, Massachusetts Institute of Technology

*Discussants:* RICHARD G. DAVIS, Federal Reserve Bank of New York

DAVID MEISELMAN, Macalester College

DONALD P. TUCKER, University of Chicago

10:30 A.M. THEORY OF THE FIRM AND OF MARKET STRUCTURES

*Chairman:* ANTHONY D. SCOTT, University of British Columbia

*Papers:* Investment in Advertising, Risk, and Profitability

WILLIAM S. COMANOR, Stanford University, and

THOMAS A. WILSON, University of Toronto

Survival-Ability as a Test of Efficiency

JOE S. BAIN, University of California, Berkeley

Allocative Efficiency and the Limits of Antitrust

OLIVER E. WILLIAMSON, University of Pennsylvania

*Summary and Further Comments:*

RICHARD B. HEFLEBOWER, Northwestern University

LESTER G. TELSER, University of Chicago

## 10:30 A.M. ECONOMIC HISTORY SESSION

*Chairman:* ALEXANDER GERSCHENKRON, Harvard University

*Papers:* Cost to America of British Imperial Policy

PETER D. McCLELLAND, Harvard University

Land Policy and Economic Growth in the United States

ROBERT W. FOGEL, University of Chicago

*Discussants:* JONATHAN R. T. HUGHES, Northwestern University

HERMAN E. KROOSS, New York University

HAROLD F. WILLIAMSON, Northwestern University

## 12:30 P.M. LUNCHEON SESSION (Jointly with the American Finance Association)

*Presiding:* HARRY C. SAUVAIN, President, A.F.A., and

KENNETH E. BOULDING, President, A.E.A.

*Chairman:* WALTER E. HOADLEY, Vice President, A.F.A.

*Speaker:* ARJAY MILLER, Vice Chairman of the Board, Ford Motor Company

Modern Management and Our Urban Problems

## 2:30 P.M. RESEARCH AND DEVELOPMENT AND OTHER DETERMINANTS OF INVESTMENT (Joint session with the Econometric Society)

*Chairman:* LAWRENCE R. KLEIN, University of Pennsylvania

*Papers:* Investment and the Frustrations of Econometricians

ROBERT EISNER, Northwestern University

Industrial Research and Development: Characteristics, Tradeoffs, and Decisions

EDWIN MANSFIELD, University of Pennsylvania

Market Structure and the Stability of Investment

FREDERIC M. SCHERER, University of Michigan

*Summary and Further Comments:* JORA R. MINASIAN, University of California, Los Angeles

*Chairman's Appraisal:* LAWRENCE R. KLEIN, University of Pennsylvania

## 2:30 P.M. STRATEGIC THEORY AND ITS APPLICATIONS

*Chairman:* JAMES M. BUCHANAN, University of California, Los Angeles

*Papers:* The Optimal Institutional Mix

MANCUR OLSON, JR., Department of Health, Education, and Welfare

Models of Segregation

THOMAS C. SCHELLING, Harvard University

Bargaining and Resource Allocation in Metropolitan Intergovernmental Relations

JEROME ROTHENBERG, Massachusetts Institute of Technology

*Discussants:* JOSEPH L. BOWER, Harvard University

DANIEL ELLSBERG, RAND Corporation

## 2:30 P.M. EXCHANGE-RATE POLICY (Round Table)

*Chairman and Moderator:* FRITZ MACHLUP, Princeton University

*Panelists:* MILTON FRIEDMAN, University of Chicago

GOTTFRIED HABERLER, Harvard University

PETER B. KENEN, Columbia University

HENRY C. WALLICE, Yale University

## 8:00 P.M. PRESIDENTIAL ADDRESS

*Chairman:* ALBERT G. HART, Columbia University

*Speaker:* KENNETH E. BOULDING, University of Colorado  
Economics as a Moral Science

## 9:15 P.M. ANNUAL BUSINESS MEETING

*Monday, December 30, 1968*

- 9:00 A.M. CENTRALIZATION AND DECENTRALIZATION IN ECONOMIC SYSTEMS (Joint session with the Association for the Study of Soviet-type Economies)  
*Chairman:* RICHARD W. JUDY, University of Toronto  
*Papers:* On the Concept and Possibility of Decentralization  
 LEONID HURWICZ, University of Minnesota  
 On the Comparison of Centralized and Decentralized Economies  
 THOMAS A. MARSCHAK, University of California, Berkeley  
 Third Paper  
*Discussants:* BELA BALASSA, Johns Hopkins University  
 ABRAM BERGSON, Harvard University
- 9:00 A.M. COMPLETED DISSERTATION RESEARCH  
*Chairman:* WILLIAM R. ALLEN, University of California, Los Angeles  
*Papers:* The Problem of Local Government Employee Shortages  
 EUGENE J. DEVINE (UCLA dissertation)  
 The Social Consequences of Individual Savings Decisions  
 RICHARD ZECKHAUSER, Harvard University  
 Effects of Taxation on Risk-Taking: A General Equilibrium Analysis  
 AIKO N. SHIBATA, Columbia University  
*Discussants:* DAVID CASS, Yale University  
 WILLIAM OAKLAND, Johns Hopkins University  
 MARK V. PAULY, Northwestern University
- 10:30 A.M. RESEARCH ON BIG CITY LABOR MARKETS (Joint session with the Industrial Relations Research Association)  
*Chairman:* MARGARET S. GORDON, University of California, Berkeley  
*Papers:* Spatial Wage Differentials in a Large City Labor Market  
 ALBERT REES, Princeton University  
 Changing Employer Policies in a Large Urban Labor Market  
 MARGARET THAL-LARSEN, University of California, Berkeley  
 Manpower Policies for Ghetto Labor Markets  
 PETER B. DOERINGER, Harvard University  
*Discussants:* GEORGE H. HILDEBRAND, Cornell University  
 WALTER H. FRANK, University of Illinois
- 11:00 A.M. THE FUTURE OF GOLD  
*Chairman:* GOTTFRIED HABERLER, Harvard University  
*Papers:* Real and Paper Gold  
 ROBERT A. MUNDELL, University of Chicago  
 Speculations on Gold Speculation  
 FRITZ MACHLUP, Princeton University  
 The Gold Rush of 1968 in Retrospect and Prospect  
 HARRY G. JOHNSON, London School of Economics and University of Chicago  
*Discussants:* EDWARD M. BERNSTEIN, EMB Ltd.  
 FRED HIRSCH, International Monetary Fund  
 MIROSLAV A. KRIZ, First National City Bank, New York
- 11:00 A.M. ALLOCATION OF RESOURCES IN LAW ENFORCEMENT (Round Table)  
*Chairman and Moderator:* THOMAS C. SCHELLING, Harvard University  
*Panelists:* ANTHONY DOWNS, JR., The Real Estate Research Corporation, Chicago  
 RICHARD B. HOFFMAN, State University of New York at Buffalo  
 WILLIAM M. LANDES, University of Chicago  
 SIMON ROTTENBERG, American Bar Foundation and Duke University

### PROTECTION OF THE AUTHOR IN THE REPRINTING OF ARTICLES\*

With the growing popularity of volumes of "Readings" consisting of articles reproduced from journals and other sources, protection of the interests of the author of the reprinted piece has become a matter of increasing concern. While journals generally have a record of protecting their authors with diligence, there have been occasional problems among which the following are noteworthy:

1. Journals, which normally hold the copyright on their contents, sometimes do not ask the author's consent before granting permission to reprint;
2. When they do ask that the author be consulted, they do not remind the author that his piece has a market value and that it may be in his interest to negotiate for a fixed fee or share of royalties;
3. Journals sometimes require a fee for permission to reprint and retain the fee without notifying the author.

As a result, an author may be surprised to find his work reprinted in a "Readings" volume, sometimes even without receiving a copy of the book. In some cases authors have objected to the nature of the reprint volume because of poor quality of printing or editing, or what may be a more serious matter, because they prefer not to be associated with some of the companion pieces of the volume, because of their quality, methodological or political orientation, etc.

To help in the prevention of such problems the Executive Committee of the American Economic Association instructed the Secretary to write to the editors of a number of leading American professional journals, suggesting that they undertake to follow several practices designed for the protection of their contributors:

1. That they permit no substantial portion of any article to be reprinted from their pages without a reasonable attempt to obtain the written consent of the author. Normally, the editor will leave the task of obtaining the author's consent to the persons wishing to reprint the piece, simply making the journal's permission contingent on the author's written concurrence.
2. That when the author is asked for his consent he be sent a form letter reminding him of the financial arrangements which he may be able to negotiate and informing him of *any fees that will be retained by the journal or its publisher.*

The author also has available a way to control personally the reprinting of his article. Rather than have its copyright status secured by the notice of copyright of the journal in which it is published, he can have copyright in his own name by having printed on the first page of the article a copyright notice "copyright (or c in a circle), author's name, 196\_\_." But this reservation of copyright by the author should be preceded by an understanding with the journal editor that the author, not the journal, is the proprietor of the copyright in the contribution. And, if the author has occasion to enforce this copyright, he will have to comply with the statutory requirements of deposit and registration.<sup>1</sup>

Two types of financial arrangement which the writer may want to consider are the fixed fee and the share of royalties. For many years the *American Economic Review* has been suggesting to the author of every article for which permission to reprint is requested that a flat fee of \$100 is an appropriate minimum on which he might want to insist. However,

\* This note was prepared at the request of the Executive Committee of the American Economic Association by W. J. Baumol and Peggy Heim:

<sup>1</sup> Those unfamiliar with the mechanics of deposit and registration should obtain Circular No. 35 from the Copyright Office, Library of Congress, Washington, D.C. 20540. For procedures with respect to works in English of U. S. citizens or domiciliaries, manufactured and first published outside the United States, consult Circular No. 69, "Ad Interim Copyright." An author publishing in a journal which conforms to the procedures recommended in this article does not, we think, need to bother with the alternative of retaining copyright in himself.

the value of the article may well vary with its length and the amount of attention which it has attracted in the profession. A piece which has met with considerable interest may add substantially to the sales of the "Readings" volume in which it appears and its author should recognize that the market value of his work will be correspondingly high. In such a case a share-of-royalty arrangement seems particularly appropriate. In other cases, potential sales revenues may not justify royalties of these magnitudes. Most writers will recognize a professional obligation to sacrifice the relatively small sums involved where this helps to stimulate the distribution of knowledge, or to permit his fees to be retained by an impecunious professional journal, or simply to permit the reproduction of his works for distribution on a nonprofit basis as a service to those who cannot afford to pay. But where a "Readings" volume is a commercial venture whose value is materially increased by the article in question, the author may well feel entitled to a share of the proceeds.<sup>2</sup>

To summarize, authors of articles will derive reassurance from the fact that the journals below have agreed to follow the procedures that have just been outlined. However, when an author submits a paper to a publication not included in this list, he may wish to ask its editor about its policy on permissions to reprint and may wish to consider insertion of the personal copyright notice described above. In any event, when an author is asked to grant permission to reprint, he should consider carefully the nature of the volume in which the piece will appear, the financial terms that he is willing to accept and the amendments, if any, that he wishes to make in his paper before it is reprinted.

*American Economist*

*American Journal of Agricultural Economics* (articles not copyrighted)

*Business Horizons*

*Canadian Journal of Economics*

*Econometrica*

*Explorations in Entrepreneurial History*

*Harvard Business Review*

*I.R.R.A. Proceedings*

*Journal of Economic History*

*Journal of Human Resources*

*Journal of Marketing*

*Journal of Marketing Research*

*Journal of Money, Credit and Banking*

*Journal of Purchasing*

*Journal of Regional Science*

*Journal of the American Statistical Association* (articles not copyrighted)

*Land Economics*

*Review of Economics and Statistics*

*Western Economic Journal*

*Yale Economic Essays*

#### CLEARINGHOUSE FOR OVERSEAS SERVICE

An arrangement has been made with the Overseas Educational Service to operate the Clearinghouse for Overseas Service by Economists starting in June, 1968. The OES is particularly well qualified in this area since for a number of years it has maintained similar rosters in cooperation with the American Library Association, the American Association of Collegiate Schools of Business, and the American Society for Engineering Education. A nonprofit organization, the activities of OES are sponsored by the American Council on Education, the National Academy of Sciences, and Education and World Affairs, and are supported by the Carnegie Corporation and the Ford Foundation. In pioneering the Clearinghouse, the American Economic Association is helping to fill a need on the part of economists interested in overseas positions as well as employers concerned with filling these positions. It is hoped that the members of the AEA will continue their participation and

<sup>2</sup>The money to pay fees is sometimes available, as indicated by the results of a survey which showed that in some cases the editor of a "Readings" volume may receive as high a royalty rate as is paid to a man who writes a book entirely by himself. William J. Baumol and Peggy Heim, "On Contracting with Publishers," *AAUP Bulletin*, March 1967, 53, 30-46.

cooperate with the OES in their efforts to maintain a roster of economists willing to become involved in international programs. The OES address is 522 Fifth Avenue, New York, N.Y. 10036.

#### NEW JOURNAL

*History of Political Economy*, a journal devoted to the history of economics in the broadest sense will be published at the Duke University Press, commencing with the Spring issue of 1969. Contributions dealing with the history of economic thought in any period or country are invited. Manuscripts submitted for consideration may be sent to Joseph J. Spengler, Craufurd D. Goodwin, or Robert S. Smith, in care of the Department of Economics, Duke University, Durham, North Carolina 27706.

#### Announcements

Omicron Delta Epsilon, the National Honor Society in Economics, has announced two national competitions for outstanding student contributions to economics: the Irving Fisher Award for book-length manuscripts by graduate students and recent Ph.D.'s and the Frank W. Taussig Award for article-length manuscripts by undergraduates and recent graduates. A National Selection Board, consisting of Professors Kenneth J. Arrow, Kenneth E. Boulding, Milton Friedman, Paul A. Samuelson, and Egon Neuberger will pick the winning entries. Professor Egon Neuberger of the Department of Economics, State University of New York, Stony Brook, N.Y., will act as editor of both competitions. Although the deadline for submissions to the Frank W. Taussig competition is now past, submissions for the Irving Fisher competition may be made up to January 1, 1969. In each case, entries should be submitted to a student's own Department Selection Board.

Winners of the Irving Fisher Award will receive a prize of \$1,000 and publication by Basic Books. The winning article in the Frank W. Taussig Award will be published in *The American Economist* and its author will receive a prize of \$100.

The National Economists Club, with headquarters in Washington, D.C., has been established to promote interchange among economists and discussion of economic subjects. The Club now holds weekly luncheon meetings, at The Brookings Institution, and evening lectures. Other facilities and services will be provided as the growth of the Club permits. The Club hopes to acquire permanent space as a center for resident and visiting economists. On April 1, 1963 the Club had about 550 members. Membership is open to all practicing economists. Dues are \$20.00 a year for residents of the Washington area and \$5.00 a year for nonresidents. Information and application forms can be obtained from the Secretary of the Club, Mr. Peter Max, National Economic Research Associates, 1120 Connecticut Avenue, N.W., Washington, D.C.

In April 1968, the Belgian Demographic Society was established for the purpose of stimulating research and teaching in the field of demography in Belgium. The Board of the Society is as follows: J. Morsa, Université Libre de Bruxelles and Centre d'Etude de la Population et de la Famille, Chairman; R. Mols, Faculté Saint-Albert, Egenhoven-Louvain, Vice-Chairman; H. Damas, Centre d'Etude de la Population et de la Famille, Treasurer; G. Wunsch, Université Catholique de Louvain, Secretary-General.

"Coping with Metropolitan-Area Water Problems" is the theme of the Fourth American (National) Water Resources Conference to be held at the Commodore Hotel in New York City, November 18 to 22, 1968. The program will also include sessions on regional planning, national water policy, and other aspects of national water resources problems. The American Water Resources Association is sponsoring the conference. Abstracts of papers on the above topics are invited for consideration. The technical program committee will also consider abstracts on any aspect of water resources research, planning, development, management, or education. Abstracts and requests for additional information about the

technical program should be directed to: Philip Cohen, U.S. Geological Survey, 1505 Kellum Place, Mineola, N.Y. 11501.

Single copies of a special issue of *Georgia Business*, which contains a tribute to David McCord Wright and his complete bibliography, may be obtained free upon request to Graduate School of Business Administration, The University of Georgia, Athens, Georgia 30601.

In 1966, the Economic Growth Center at Yale University published *The Soviet Capital Stock, 1928-1962* by Richard Moorsteen and Raymond P. Powell (Homewood: Richard D. Irwin, 1966). A soft-cover *Two Supplements* to that volume now available free of charge, consists of two parts: I. *The Soviet Capital Stock: Revisions and Extensions, 1961-1967*, by Abraham S. Becker, Richard Moorsteen and Raymond P. Powell; II, *The Soviet Capital Stock and Related Statistical Series for the War Years*, by Raymond P. Powell. Purchasers of the initial Moorsteen-Powell volume may obtain single copies of the *Two Supplements* by writing to: Miss Billie Salter, Librarian, Economic Growth Center, Yale University, Box 1987, Yale Station, New Haven, Connecticut 06520.

### Deaths

Alvin E. Coons, professor of economics, The Ohio State University, February 22, 1968.  
Robert D. Entenberg, College of Business Administration, University of Denver, January 1968.

Ralph E. Freeman, Chestnut Hill, Massachusetts, May 12, 1967.

Earl S. Garver, professor of economics and dean, Manchester College, March 13, 1968.

Ernest E. Heimbach, Upsala College, East Orange.

Alma Herbst, professor emeritus, The Ohio State University, January 18, 1968.

Ervin P. Hexner, professor emeritus, The Pennsylvania State University, May 15, 1968.

Robert Hofmann, Ferguson, Missouri, October 24, 1967.

John Legan, Rahway, N.J., September 1967.

David A. Lehan, Storrs, Connecticut.

Alonzo B. May, professor of economics, University of Denver.

Morris R. Neifeld, Maplewood, New Jersey, February 1, 1968.

Philip C. Newman, Ridgewood, New Jersey, February 24, 1968.

James R. Ott Jr., associate professor of finance, University of Alabama, April 7, 1968.

Jacob Perlman, in Haifa, Israel, April 8, 1968.

Edward G. Posniak, Washington, D.C., January 20, 1968.

Orvis A. Schmidt, Chevy Chase, Maryland, November 20, 1967.

Hermann Steinhardt, Portland, Oregon.

Everet M. Straus, Detroit, Michigan, November 23, 1967.

Arthur S. Thornbury, Detroit, Michigan, April 30, 1967.

Robert H. Tucker, Halifax, Virginia, June 1967.

Adna F. Weber, Richmond Hill, N.Y., February 28, 1968.

C. E. Whipple, American Embassy, Brussels, March 6, 1968.

### Retirements

Ralph M. Barnes, professor of production management and engineering, University of California, Los Angeles, July 1968.

Edison L. Bowers, professor of economics, The Ohio State University, September 30, 1968.

Ralph Cassady Jr., professor of marketing, University of California, Los Angeles, July 1968.

- William E. Dunkman, professor of economics, University of Rochester, July 1, 1968.
- R. Parker Eastwood, professor, Columbia Business School, July 1, 1968.
- Harold M. Groves, professor of economics, University of Wisconsin, June 1968.
- Boris Ischboldin Al Bakri, professor of economics, St. Louis University, July 1968.
- Eugene S. Klise, professor of economics, Miami University, August 1968.
- Martin L. Lindahl, professor of economics, Dartmouth College, June 1968.
- William N. Loucks, professor of economics, University of Pennsylvania, June 1967.
- Vaclav E. Mares, professor of economics, The Pennsylvania State University, July 1, 1968.
- Emmett B. McNatt, professor of economics, University of Illinois.
- Wayne L. McNaughton, professor of business administration, University of California, Los Angeles, July 1968.
- Cyril J. O'Donnell, professor of business organization and policy, University of California, Los Angeles, July 1968.
- Shorey Peterson, professor of economics, University of Michigan, July 1968.
- Ralph R. Pickett, professor of business administration, University of Kentucky, July 1, 1968.
- Walter H. Pierce, professor of economics, North Carolina State University, April 1968.
- J. S. Spratt, professor of economics, Southern Methodist University, May 1968.
- Corydon P. Spruill, professor of economics, University of North Carolina.
- Ernst W. Swanson, professor of economics, North Carolina State University, June 1968.

### *Visiting Foreign Scholars*

- Aleksander Bajt, University of Ljubljana, Yugoslavia: visiting professor of economics, University of Virginia, 1968-69.
- Jean Benard, University of Poitiers, Paris: honorary research associate in economics, Harvard University, 1968-1969.
- Karl Borch, The Norwegian School of Economics and Business Administration: visiting professor of economics, The Ohio State University, 1968-69.
- Gunnar Bramness, University of Oslo: visiting lecturer in economics, University of Oregon, 1968-69.
- Bryan V. Carsberg, London School of Economics: visiting lecturer in accounting, Graduate School of Business, University of Chicago.
- Ronald I. Findlay, University of Rangoon: visiting professor of economics, Columbia University, 1968-69.
- George B. France, University of York, England: visiting assistant professor of economics, University of Connecticut, 1968-69.
- Hamid Habibagahi, Pahlavi University, Iran: visiting assistant professor of economics, University of Pennsylvania, 1968-69.
- Sir Roy Harrod, Christ Church, Oxford: visiting professor of economics, University of Pennsylvania, spring 1969.
- Yujiro Hayami, Tokyo Metropolitan University: visiting associate professor of agricultural economics, University of Minnesota, 1968-70.
- William Hutt: visiting professor of economics, Texas A&M University.
- Zoltan Kenessey, United Nations: visiting lecturer in economics, University of Pennsylvania, fall 1968.
- Ephraim Kleiman, The Hebrew University: visiting lecturer in economics, University of Pennsylvania, 1968-69.
- Helen F. Locke, London School of Economics: visiting lecturer in economics, Dartmouth College.



Maurice G. Marchand, Université Catholique de Louvain: visiting assistant professor of applied economics, Graduate School of Business, University of Chicago.

Tadeusz I. Matuszewski, Laval University, Quebec: visiting professor of economics, Harvard University, first semester 1968-69.

Marvin McNinnis, Queen's University: visiting lecturer in economics, University of Pennsylvania, spring 1969.

Graham McLaren, Monash University, Victoria, Australia: visiting lecturer in economics, University of Pennsylvania, fall 1968.

Andras Nagy, Institute for Economic and Market Research, Budapest: visiting professor, Johns Hopkins University, Feb. 1969 term.

Patrick O'Brien, University of London: visiting lecturer in economics, Harvard University, 1968-1969.

Dale K. Osborne, University of Birmingham: visiting associate professor of economics, University of Illinois, 1968-69.

John O'Shaughnessy, College of Aeronautics, Cranfield, England: visiting associate professor, Graduate School of Business, Columbia University, July 1, 1968.

Johannes Overbeek, Graduate Institute of International Studies, Geneva: visiting assistant professor of economics, University of British Columbia.

Diana C. Pheysey, The University of Aston in Birmingham, Birmingham, England: visiting assistant professor, College of Business Administration, Kent State University.

James Potter, London School of Economics: visiting professor of economics, University of Kansas, fall 1968.

Pierluigi Profumieri, University of Parma: visiting assistant professor of economics, University of Connecticut, 1968-69.

Grant L. Reuber, University of Western Ontario: honorary research associate, Harvard University, 1968-1969.

Amartya K. Sen, Delhi School of Economics: visiting professor of economics, Harvard University, 1968-1969.

Manuel Sigilenza, Universidad de Deusta, Bilbao, Spain: visiting lecturer in economics, University of Pennsylvania, 1968-69.

Max D. Steuer, London School of Economics: visiting professor of economics, University of Pennsylvania, spring term 1969.

James Taylor, Lonsdale College, Lancaster, England: visiting lecturer in economics, University of Pennsylvania, 1968-69.

Richard D. Terrell, Australian National University, Canberra: visiting lecturer in economics, University of Pennsylvania, spring term 1969.

Carl C. von Weizsäcker: visiting professor of economics, Massachusetts Institute of Technology, spring terms 1969-1970.

Manfred Willms, University of Bonn: visiting assistant professor, University of Illinois, 1968-69.

### *Promotions*

Clopper Almon Jr.: professor of economics, University of Maryland.

W. H. Locke Anderson: professor of economics, University of Michigan.

J. Richard Aronson: associate professor of economics, Lehigh University.

R. M. Arunachalam: professor of economics, Virginia State College, Norfolk.

David S. Ball: associate professor of economics, North Carolina State University.

Ernest Bartell: associate professor of economics, University of Notre Dame.

Gary S. Becker: Arthur Lehman Professor of Economics, Columbia University.

Jere R. Behrman: associate professor of economics, University of Pennsylvania.

Ivar E. Berg Jr.: professor, Graduate School of Business, Columbia University.

Stanley M. Besen: associate professor of economics, Rice University.

John O. Blackburn: professor of economics, Duke University.

David A. Bowers: associate professor of economics, Case Western Reserve University.

Gerald P. Brady: professor, Graduate School of Business, Columbia University.

Philip R. Brown: assistant professor of accounting, Graduate School of Business, University of Chicago.

John Buckley: associate professor of accounting, University of California, Los Angeles.

Leonard R. Burgess: professor of management, School of Business Administration, Texas A&M University.

Edwin Burmeister: associate professor of economics, University of Pennsylvania.

Leland S. Burns: professor of urban land economics, University of California, Los Angeles.

Helen A. Cameron: associate professor of economics, Ohio State University.

James M. Carman: associate professor of business administration, University of California, Berkeley.

Perry P. Chang: professor of economics, University of Nebraska at Omaha.

Yung-Ping Chen: associate professor of economics, University of California, Los Angeles.

Gerald L. Childs: associate professor of economics, Dartmouth College.

James W. Christian: associate professor of economics, Iowa State University.

Martin K. Christiansen: associate professor of agricultural economics and extension economist in marketing, University of Minnesota.

Joseph S. Chung: associate professor of economics, Illinois Institute of Technology.

Pham Chung: associate professor of economics, University of New Mexico.

Harold A. Cohen: assistant professor of economics, University of Georgia.

John G. Cragg: associate professor of economics, University of British Columbia.

Woodrow W. Creason: professor of economics, Indiana State University.

John Cross: associate professor of economics, University of Michigan.

Gregory L. Curme: associate professor of economics, University of Notre Dame.

John C. Dawson: professor of economics, Grinnell College.

Richard Day: professor of economics, University of Wisconsin.

Thomas R. DeGregori: associate professor of economics, University of Houston.

Kenneth M. Deitch: assistant professor, Harvard University.

William G. Dewald: professor of economics, Ohio State University.

John A. Doukas: associate professor of economics, Miami University.

Emmanuel Drandakis: professor of economics, University of Rochester.

L. Aubrey Drewry Jr.: professor, College of Business Administration, University of Georgia.

C. E. Edwards: professor of business administration, University of South Carolina.

Franklin R. Edwards: associate professor, Graduate School of Business, Columbia University.

Michael K. Evans: associate professor of economics, University of Pennsylvania.

Eugene F. Fama: professor of finance, Graduate School of Business, University of Chicago.

Robert M. Fearn: associate professor of economics, North Carolina State University.

Martin S. Feldstein: associate professor of economics, Harvard University.

John R. Felton: professor of economics, University of Nebraska.

Lawrence Fisher: professor of finance, Graduate School of Business, University of Chicago.

Arthur Geoffrion: associate professor of quantitative methods, University of California, Los Angeles.

Charles J. Goetz: associate professor of economics, Virginia Polytechnic Institute.

Niles M. Hansen: professor of economics, University of Kentucky.

Paul T. Hartman: associate professor of economics, University of Illinois.

Irwin Harvey: assistant professor of finance, College of Business Administration, University of Georgia.

Dale S. Harwood Jr.: professor of accounting and business statistics, College of Business Administration, University of Oregon.

Paul S. Hasbargen: professor of agricultural economics and extension economist in farm management, University of Minnesota.

Samuel L. Hayes III: associate professor, Graduate School of Business, Columbia University, summer 1968.

Donald G. Heckerman: assistant professor of business economics, Graduate School of Business, University of Chicago.

A. H. Heins: professor of economics, University of Illinois.

H. Robert Heller: associate professor of economics, University of California, Los Angeles.

John D. Helmberger: professor of agricultural economics, University of Minnesota.

William W. Hicks: associate professor of economics, University of Missouri.

Alfred Hofflander: associate professor of risk bearing and insurance, University of California, Los Angeles.

Austin C. Hoggatt: professor of business administration, University of California, Berkeley.

Bob R. Holdren: professor of economics, Iowa State University.

Dale M. Hoover: professor of economics, North Carolina State University.

Ke Ting Hsia: associate professor of economics, School of Business and Economics, California State College, Los Angeles.

Gary Hufbauer: associate professor of economics, University of New Mexico.

A. M. Huq: adjunct professor of economics, North Carolina State University.

Walter L. Johnson: associate professor of economics, University of Missouri.

Ethel B. Jones: professor of economics, University of Georgia.

Marvin G. Julius: associate professor of economics, Iowa State University.

John F. Kain: associate professor of economics, Harvard University.

David R. Kamerschen: professor of economics, University of Missouri.

Herbert J. Kiesling: associate professor of economics, Indiana University.

B. F. Kiker: associate professor of economics, University of South Carolina.

Benjamin F. King Jr.: associate professor of statistics, Graduate School of Business, University of Chicago.

John J. Korbel: professor of economics and business, Whittemore School of Business and Economics, University of New Hampshire.

Iwan Koropeczyk: associate professor of economics, Temple University.

Burton G. Malkiel: professor of economics, Princeton University.

Stephen A. Marglin: associate professor of economics, Harvard University.

Wayne S. Marshall: associate professor, Graduate School of Business, Columbia University.

Thomas A. Martinsek: professor of economics, Southern Illinois University.

Richard C. Maxon: associate professor of economics, Iowa State University.

Peter McClelland: assistant professor, Harvard University.

L. Randolph McGee: associate professor of economics, University of Kentucky.

C. Bartlett McGuire: professor of business administration, University of California, Berkeley.

Robert B. McKersie: professor of industrial relations, Graduate School of Business, University of Chicago.

Paul J. McNulty: associate professor, Graduate School of Business, Columbia University.

Carmen Menezes: associate professor of economics, University of Missouri.

Jan M. Michal: professor of economics, State University of New York at Binghamton.  
Raymond E. Miles: associate professor of business administration, University of California, Berkeley.

Ise Mintz: professor of economics, Columbia University.

Donald G. Morrison: associate professor, Graduate School of Business, Columbia University.

Gordon R. Munro: associate professor of economics, University of British Columbia.

Milton L. Myers: associate professor of economics, University of Connecticut.

James Nakamura: associate professor of economics, Columbia University.

John C. Narver: associate professor of business administration, University of Washington.

Thomas H. Naylor: professor of economics, Duke University.

Rosser T. Nelson: associate professor of operations management and quantitative methods, University of California, Los Angeles.

Francesco M. Nicosia: professor of business administration, University of California, Berkeley.

Hugh O. Nourse: professor of economics, University of Illinois.

Daniel Orr: professor of economics, University of California, San Diego.

B. Peter Pashigian: professor of business economics, Graduate School of Business, University of Chicago.

Hugh T. Patrick: professor of economics, Yale University.

Robert Pollak: associate professor of economics, University of Pennsylvania.

William Pollak: assistant professor of economics, Grinnell College.

Giulio Pontecorvo: professor, Graduate School of Business, Columbia University.

Richard Porter: professor of economics, University of Michigan.

Henry B. Reiling: associate professor, Graduate School of Business, Columbia University.

George E. Rejda: professor of economics, University of Nebraska.

Barry Richman: professor of management theory, University of California, Los Angeles.

Ingrid H. Rima: professor of economics, Temple University.

Perry Roets: associate professor of economics, Marquette University.

Sherwin Rosen: associate professor of economics, University of Rochester.

Barr Rosenberg: assistant professor of business administration, University of California, Berkeley, April 1968.

Marion Ross: professor of economics, Mills College.

Reynold M. Sachs: associate professor, Graduate School of Business, Columbia University.

Romesh Saigal: assistant professor of business administration, University of California, Berkeley, March 1968.

Ronald A. Schrimper: associate professor of economics, North Carolina State University.

James A. Seagraves: professor of economics, North Carolina State University.

C. Prakash Sethi: assistant professor of business administration, University of California, Berkeley, November 1967.

John P. Shelton: professor of finance, University of California, Los Angeles.

Ching S. Shen: associate professor of economics, Lehigh University.

Keith R. Shwayder: assistant professor of accounting, Graduate School of Business, University of Chicago.

Ammar Siamwalla: assistant professor of economics, Yale University.

Richard L. Simmons: professor of economics, North Carolina State University.

Christopher A. Sims: assistant professor, Harvard University.

Francis J. Smith Jr.: professor of agricultural economics and extension economist in marketing, University of Minnesota.

Martin B. Soloman Jr.: associate professor of economics, University of Kentucky.

Don M. Soule: professor of economics, University of Kentucky.

Dennis R. Starleaf: associate professor of economics, Iowa State University.

Henry B. Steele: professor of economics, University of Houston.

Thomas Stevenson: associate professor of economics, Saint Louis University.

Joseph E. Stiglitz: associate professor of economics, Yale University.

Paul Swadener: assistant professor of insurance, College of Business Administration, University of Oregon.

Paul J. Taubman: associate professor of economics, University of Pennsylvania.

Russell A. Taussig: professor, Graduate School of Business, Columbia University.

Arthur L. Thomas: professor, department of accounting and business statistics, College of Business Administration, University of Oregon.

Kenneth H. Thomas: assistant professor of agricultural economics and extension economist in farm management, University of Minnesota.

Russell G. Thompson: professor of economics, Texas A&M University.

Lloyd M. Valentine: professor of economics, University of Cincinnati.

John Vanderkamp: associate professor of economics, University of British Columbia.

Robert F. Voertman: professor of economics, Grinnell College.

Donald A. Walker: associate professor of economics, Miami University.

Ray M. Ware: professor of economics and business administration, Transylvania College.

Rufus Waters: assistant professor of economics, Texas A&M University.

Richard S. Weckstein: professor of economics, Brandeis University.

Finis Welch: associate professor of economics, Southern Methodist University.

B. J. Widick: associate professor of economics, Wayne State University.

Maurice Wilkinson: associate professor, Graduate School of Business, Columbia University.

Thomas D. Willett: assistant professor of economics, Harvard University.

Jeffrey Williamson: professor of economics, University of Wisconsin, Madison.

Oliver E. Williamson: professor of economics, University of Pennsylvania.

John R. Wish: associate professor, department of marketing, insurance and transportation, College of Business Administration, University of Oregon.

James G. Witte Jr.: professor of economics, Indiana University.

O. G. Wood Jr.: associate professor of economics, University of South Carolina.

Mahmood A. Zaidi: associate professor of industrial relations and manpower economics, University of Minnesota.

Oleg Zinam: associate professor of economics, University of Cincinnati.

### *Administrative Appointments*

William H. Anderson: chairman, department of economics, Claremont Men's College, and director, Lincoln School of Public Finance.

Richard F. Barton: director, Office of Planning and Analyses, Texas Technological College, Lubbock.

Joseph S. Berliner: chairman, department of economics, Brandeis University.

John O. Blackburn: chairman, department of economics, Duke University.

Leonard F. Cain: associate professor of economics and dean, College of Arts and Sciences, Catholic University of America, October 1967.

Charles W. Campbell, III, University of Kentucky: chairman, department of economics, Centre College.

Anne P. Carter: senior research associate in economics and director of research, Harvard Economic Research Project, Harvard University.

M. O. Clement: acting chairman, department of economics, Dartmouth College.

Louis A. Dow: chairman, department of economics, University of Houston.

Eldon J. Dvorak: chairman, department of economics, California State College at Long Beach.

Noel J. J. Farley: associate professor and chairman, department of economics, Goucher College; succeeding Frederick G. Reuss.

George Fisk, Temple University: chairman, department of marketing, College of Business Administration, Syracuse University; succeeding George Saunders.

Victor R. Fuchs: vice president-research, National Bureau of Economic Research.

Galvin G. Gall: assistant provost, University of Connecticut.

Craufurd D. Goodwin: professor of economics and vice-provost for international studies, Duke University.

Peter Gray, Wayne State University: professor and chairman, department of economics, Douglass College, Rutgers—The State University.

Myron Grove: head, department of economics, University of Oregon.

Roy B. Helfgott: professor of industrial relations and chairman, department of industrial relations, Newark College of Engineering.

Hans E. Jensen: head, department of economics, University of Tennessee.

Raymond C. Kenney: director of executive programs, Graduate School of Business, Columbia University, May 1, 1968.

Hal B. Lary: director, International Studies, National Bureau of Economic Research.

Roy L. Lassiter, Jr.: associate dean of academic affairs, University of Florida.

Richard A. Lester: dean of the faculty, Princeton University.

David Wei-Ping Liu: professor of economics and chairman, social science department, Stout State University.

David McFarland: chairman, department of economics, University of North Carolina.

Roger P. Mendels: economist, Asian Development Bank, Manila.

Frederic Meyers: associate dean, Graduate School of Business Administration, University of California, Los Angeles.

Richard A. Miller: chairman, department of economics, Wesleyan University.

Paul A. Montavon: deputy assistant director, Development Planning, USAID Mission, Rio de Janeiro, Brazil.

Geoffrey H. Moore: vice president-research, National Bureau of Economic Research.

Nilan Norris: chairman, department of economics, Herbert H. Lehman College (formerly Hunter College in the Bronx).

Richard L. Oliner, Indiana University: associate professor of management and associate dean, College of Business Administration, Syracuse University; succeeding Raymond Valenti, who continues as director of the doctoral program.

Rudolph G. Penner: acting chairman, department of economics, University of Rochester, 1968-69.

Almarin Phillips: chairman, department of economics, University of Pennsylvania.

Richard D. Quandt: chairman, department of economics, Princeton University.

R. Bruce Ricks: associate professor of finance and assistant dean, Graduate School of Business Administration, University of California, Los Angeles.

George W. Robbins: dean, Graduate School of Business Administration, University of California, Los Angeles, succeeding Neil H. Jacoby.

Robert A. Robertson: professor and chairman, department of economics, Indiana State University.

Roy J. Sampson: acting director, Transportation and Logistics Research Center, College of Business Administration, University of Oregon.

Gilbert Y. Steiner: director, governmental studies, Brookings Institution.

Benjamin J. Taylor: associate professor of economics and director, Bureau of Business and Economic Research, College of Business Administration, Arizona State University.

Joseph M. Thorson: professor and chairman, department of economics-business administration, West Chester State College, West Chester, Pennsylvania.

James Tobin: chairman, department of economics, Yale University.

John H. Young: acting dean, faculty of arts, University of British Columbia.

Raymond J. Ziegler: associate dean, College of Business Administration, Cleveland State University.

### *Appointments*

David A. Aaker: acting assistant professor of business administration, University of California, Berkeley.

Donald R. Adams, United States Naval Academy, Annapolis: assistant professor, Southern Illinois University.

Robert F. Adams: associate professor of economics, Crown College, University of California, Santa Cruz.

F. Michael Adler, University of Pennsylvania: assistant professor, Graduate School of Business, Columbia University.

Sydney N. Afriat: professor of economics, University of North Carolina.

Richard J. Agnello: instructor in economics, University of Delaware.

Robert F. Allen: assistant professor of economics, University of Nebraska.

Ogden O. Allsbrook Jr.: assistant professor of economics, University of Georgia.

Hector R. Anton: Ford Foundation Visiting Professor of Accounting, Graduate School of Business, University of Chicago.

Masahiko Aoki, Stanford University: assistant professor of economics, Harvard University.

Fred D. Arditti: assistant professor of business administration, University of California, Berkeley.

Karl Asmus: assistant professor of economics, Texas A&M University.

Kenneth J. Arrow, Stanford University: professor of economics, Harvard University.

Martin Bailey: professor, department of economics and College of Business, University of Rochester.

Charles W. Baird: assistant professor of economics, University of California, Los Angeles.

Ernst Baltensperger, The Johns Hopkins University: assistant professor of economics, Ohio State University.

A. Paul Baroutsis: assistant professor of economics, Virginia Polytechnic Institute.

Paul R. Beach: assistant professor of economics, Arizona State University.

David Behling: lecturer in economics, Indiana University.

Thomas Bell: assistant professor of operations management, University of California, Los Angeles.

Miloslav Bernasek, Albion College: visiting professor, Boston University.

Gary Bickel, Appalachian Volunteers, Inc.: associate professor of economics, Cornell University.

John S. Bickley: Alabama Insurance Industry Professor of Insurance, University of Alabama.

Thomas B. Birnberg: lecturer in economics, Yale University.

Erwin A. Blackstone: instructor in economics, Dartmouth College.

Forrest C. Blodgett, U. S. Air Force, (Ret.): assistant professor of economics, Linfield College.

Vittorio A. Bonomo: associate professor of economics, Virginia Polytechnic Institute.

Leonard G. Bower, Duke University: assistant professor, Florida State University.

Gary W. Bowman: lecturer in economics, Rutgers College, Rutgers—The State University.

Gerald Boyle: professor of economics, University of New Mexico.

Jack T. Brimer: assistant professor of economics, School of Business and Economics, California State College, Los Angeles.

Ronald Britto: assistant professor of economics, University of California, Los Angeles.

M. Neil Browne: assistant professor of economics, Bowling Green State University.

John M. Bruner: instructor in economics, Arizona State University.

Brian Brush: assistant professor of economics, Marquette University.

James M. Buchanan: professor of economics, University of California, Los Angeles.

Byron M. Bunger: University of Colorado: assistant professor, Southern Illinois University.

Wynn V. Bussmann, University of Wisconsin: assistant professor of economics, Cornell University.

John Butts, Cornell University: assistant professor of economics, Case Western Reserve University.

Gary Cadenhead: acting assistant professor of accounting and management information systems, University of California, Los Angeles.

John Chang, Wisconsin State University: assistant professor, Florida State University.

Robert Cherry, University of Kansas: assistant professor of economics, Case Western Reserve University.

Rockwood Chin, Wheaton College: professor of economics, University of Connecticut.

Gregory C. Chow, IBM: adjunct professor, Columbia University.

Charles J. Cicchetti: instructor in economics, Rutgers College, Rutgers—The State University.

Christopher K. Clague, Harvard University: assistant professor of economics, University of Maryland.

C. Wade Clifton: assistant professor of economics, University of Texas.

James L. Cochrane, Tulane University: assistant professor of economics, University of South Carolina.

Benjamin Cohen: associate professor of economics, Yale University.

Malcolm Cohen: assistant professor of economics, University of Michigan.

Elchanan Cohn: assistant professor of economics, Pennsylvania State University.

Robert Cohn: assistant professor of economics, School of Business and Economics, California State College, Los Angeles.

John Conlisk, University of Wisconsin: associate professor of economics, University of California, San Diego.

Alvin A. Cook Jr.: staff member, logistics department, The RAND Corporation.

Michael D. Copeland, The City University of New York: lecturer in economics, York University, Toronto.

William A. Cox: visiting assistant professor, University of Southern California, 1968-69.

Simeon J. Crowther, University of Pennsylvania: assistant professor, California State College at Long Beach.

William P. Culbertson Jr.: acting assistant professor of economics, University of Virginia, 1968-69.

Lauchlin Currie, presently visiting professor, University of Glasgow: professor, department of economics and commerce, Simon Fraser University, 1969.

Andre Danieri, Harvard University: associate professor, Boston College.

John R. Darling, University of Alabama: University of Missouri.

Louis De Alessi: professor of economics, The George Washington University.

Edwin R. Dean, Columbia University: Queen's College.

Vincent DeAndrea, University of Massachusetts: Quinnipiac College.

Charles D. DeLorme Jr.: assistant professor of economics, University of Georgia.



Paul Demeny, University of Michigan: visiting associate professor, University of California, Berkeley, fall term 1968.

Robert Dernberger, University of Chicago: associate professor of economics, University of Michigan.

A. R. Dobell, Harvard University: University of Toronto.

F. Trenery Dolbear Jr.: associate professor of economics, Brandeis University.

Lawrence P. Donnelley: instructor in economics, University of Delaware.

James H. Donnelly Jr.: assistant professor of business administration, University of Kentucky.

Robert M. Dunn Jr.: assistant professor of economics, The George Washington University.

Dean S. Dutton: assistant professor of economics, Brigham Young University.

Warren W. Eason, Syracuse University: professor of economics, Ohio State University.

Curtis Eaves: acting assistant professor of business administration, University of California, Berkeley, July 1, 1968.

Arfan S. El-Azmeh, Central Bank of Syria: Baldwin-Wallace College, 1968-69.

Bryan Ellickson: acting assistant professor of economics, University of California, Los Angeles.

Robert E. Evenson: visiting assistant professor of economics, Southern Methodist University.

Donald E. Farrar, Massachusetts Institute of Technology: associate professor, Graduate School of Business, Columbia University.

Paul Feldstein: associate professor of economics, University of Michigan.

Stefano Fenoaltea, Harvard University: assistant professor of economics, University of Pennsylvania.

Charles E. Ferguson: professor of economics, Texas A&M University.

Gerald E. Flueckiger, Purdue University: assistant professor of economics, Miami University.

Curtis F. Forner: assistant professor of economics, Hunter College.

Melvin C. Fredlund: assistant professor of economics, Wayne State University.

Deborah Freedman: lecturer in economics, University of Michigan.

James W. Friedman, Yale University: associate professor of economics, University of Rochester.

Mark B. Garman: acting assistant professor of business administration, University of California, Berkeley, April 1969.

Marsha L. Geier: lecturer in economics, Yale University.

Richard H. Geissenhainer: instructor in economics, Miami University.

Erika Georges: assistant professor of economics, School of Business and economics, California State College, Los Angeles.

J. Fred Giertz, Northwestern University: assistant professor of economics, Miami University.

Constantine Glezakos, University of Southern California: assistant professor, California State College at Long Beach.

Robert Goldfarb: lecturer in economics, Yale University.

Michael Granfield: acting assistant professor of business economics and urban land economics, University of California, Los Angeles.

Jean M. Gray: lecturer in economics, Rutgers College, Rutgers—The State University.

A. Ray Grimes Jr.: assistant professor of economics, University of Georgia.

Andrew J. Grines: associate professor of business administration, University of Kentucky.

William D. Guth, Harvard Business School: professor, Graduate School of Business, Columbia University.

Richard D. Haas: assistant professor of economics, University of Georgia.

Geoffrey B. Hainsworth: assistant professor of economics, University of British Columbia.

James Hamilton: instructor in economics, Grinnell College.

Donald Harris, Northwestern University: assistant professor, University of Wisconsin, Madison.

Charles T. Haworth, University of Oregon: assistant professor, Florida State University.

Jared E. Hazleton: lecturer in economics, University of Texas.

Dale Henderson, Yale University: assistant professor of economics, University of Pennsylvania.

Rolf Henriksson: assistant professor of economics, University of Texas.

Donald Hester, Yale University: professor, University of Wisconsin.

Stephen A. Hoenack: adjunct assistant professor, The George Washington University.

Paul M. Hohenberg, Stanford University: associate professor of economics, Cornell University.

Grace Horowitz: assistant professor of economics, State University of New York, College at Brockport.

L. Kenneth Hubell, University of Nebraska: assistant professor of economics, University of Missouri, Kansas City.

Jerry G. Hunt, University of Colorado: assistant professor of economics, New Mexico State University.

Robert C. Hutchins: assistant professor, department of business law and finance, School of Business Administration, San Diego State College.

George R. Iden: assistant professor of economics, University of North Carolina.

John W. Isbister: assistant professor of economics, Merrill College, University of California, Santa Cruz.

John M. Ivancevich: assistant professor of business administration, University of Kentucky.

F. Tomasson Jannuzi: lecturer in economics, University of Texas.

Craig G. Johnson, University of California, Los Angeles: associate in business, Graduate School of Business, Columbia University.

Madelyn L. Kafoglis, University of Florida: visiting associate professor of economics, Ohio State University.

Milton Z. Kafoglis, University of Florida: visiting professor of economics, Ohio State University.

Maxwell Kaufman: lecturer in finance, University of California, Los Angeles.

Barbara H. Kehr: assistant professor of economics, Fisk University.

Kenneth C. Kehr: assistant professor of economics, Fisk University.

Michael G. Kelly, Brookings Institution: assistant professor of economics, University of British Columbia.

Jerry C. Kenley: assistant professor of economics, California State College at Hayward.

Dudley M. Kessel: assistant professor, Goucher College.

Bruce W. Kimzey, Washington State University: assistant professor of economics, New Mexico State University.

Michael Klass: assistant professor of economics, University of Michigan.

Benjamin Klein: acting assistant professor of economics, University of California, Los Angeles.

George B. Kleindorfer: lecturer in business administration, University of California, Berkeley.

Erich Klinkmuller: visiting associate professor, University of Southern California, 1968-69.

Allen V. Kneese: visiting professor of economics, University of New Mexico, 1968-69.

Lewis E. Knollmeyer, U. S. Air Force (Ret.): staff member, cost department, The RAND Corporation, March 1968.

James C. Knowles, University of Wisconsin: instructor in economics, Dartmouth College.

T. Krishna Kumar: post-doctoral associate in economics, Iowa State University.

Gerald Lage, Oklahoma State University: visiting assistant professor, University of Wisconsin.

George H. Lamson, Loyola University: visiting assistant professor of economics, University of Connecticut.

James W. Land, Yale University: adjunct associate professor, Rice University, 1968-69.

Victoria Lapham, Southern Methodist University: assistant professor of economics, Case Western Reserve University.

Robert Larner: assistant professor of economics, Brandeis University.

Dennis LaVigne: instructor in economics, Miami University, Hamilton.

Maw Lin Lee: professor of economics, community health and medical practice, University of Missouri.

Baruch Lev: instructor in accounting and finance, Graduate School of Business, University of Chicago.

Irving Leveson: economist, staff of the RAND Corporation, New York.

Jay Levin, University of Michigan: assistant professor of economics, Cornell University.

Erwin E. Liebhafsky, University of Houston: professor of economics and Faculty Research Professor, University of Missouri.

Jon C. Lindgren: assistant professor of economics, North Dakota State University.

David E. Lindsey, University of Chicago: assistant professor of economics, Ohio State University.

William L. Littlejohn: assistant professor of economics, University of Missouri.

C. A. Knox Lovell: assistant professor of economics, University of North Carolina.

Peter Lundt: assistant professor of economics, University of Oregon.

Herbert L. Lyon: assistant professor of business administration, University of Kentucky.

Michael K. Madden: assistant professor, University of Wyoming.

Michael Magill: lecturer in economics, Indiana University.

Karl O. Magnusen, University of Wisconsin: associate in business, Graduate School of Business, Columbia University, spring 1969.

George M. Maniatis: visiting associate professor of economics, Syracuse University.

Michael Manove: assistant professor of economics, University of Michigan, winter 1969.

Donald L. Martin, University of California, Los Angeles: acting assistant professor of economics, University of Virginia, 1968-69.

Richard Mason: acting assistant professor of management information systems, University of California, Los Angeles.

Josef May: assistant professor of economics, University of California, Los Angeles.

Peter C. Mayer, University of California, Berkeley: assistant professor of economics, Miami University.

James A. Maxwell: visiting university professor of economics, University of Connecticut, 1968-69.

Donald N. McCloskey: department of economics, University of Chicago.

John McDonough: acting assistant professor of accounting and management information systems, University of California, Los Angeles.

E. Michael McMahon: lecturer, department of economics and commerce, Simon Fraser University.

Paul C. Medow, New School for Social Research: associate professor of economics, York University, Toronto.

John W. Merck: staff member, logistics department, The RAND Corporation, summer 1967

Leonard Merewitz: acting assistant professor of business administration, University of California, Berkeley, July 1968.

Emil M. Meurer Jr., Mankato State College: instructor in economics, University of Nebraska.

John R. Meyer, Harvard University: professor of economics, Yale University.

Howard Meyers: assistant professor of economics, Rutgers—The State University.

Robert T. Michael: acting assistant professor of economics, University of California, Los Angeles.

Norman N. Mintz, Syracuse University: visiting assistant professor, Columbia University, 1968-69.

Daniel Mitchell: assistant professor of industrial relations, University of California, Los Angeles.

Theodore Mock: acting assistant professor of accounting and management information systems, University of California, Los Angeles.

Ronald L. Moomaw, Princeton University: acting assistant professor of economics, University of Virginia, 1968-69.

Joseph Mooney, Princeton University: associate professor of economics, University of Michigan.

Samuel Morley, University of California, Berkeley: assistant professor, University of Wisconsin, Madison.

William E. Morgan: assistant professor, University of Wyoming.

George R. Morrison, First National City Bank (New York): associate professor of economics, University of California, San Diego.

Lynn Muchmore: instructor of economics, Grinnell College.

Dennis C. Mueller, Brookings Institution: assistant professor of economics, Cornell University.

Peggy Musgrave: associate professor, Northeastern University.

Myron G. Myers: lecturer in economics, Rutgers College, Rutgers—The State University.

Mohammed I. Nadiri, Northwestern University: associate professor, Graduate School of Business, Columbia University.

Keizo Nagatani, Brown University: assistant professor of economics, University of British Columbia.

Richard R. Nelson: professor of economics, Yale University.

S. H. Nerlove: professor in residence of economics and business policy, Graduate School of Business Administration, University of California, Los Angeles.

Victor Niederhoffer: acting assistant professor of business administration, University of California, Berkeley.

Albert W. Niemi Jr.: assistant professor of economics, University of Georgia.

Emlyn A. Norman: instructor, Northeastern University.

Thomas O'Brien: assistant professor of economics, Brandeis University.

William O'Connor: assistant professor of economics, University of Missouri.

Kent W. Olson: assistant professor of economics, Arizona State University.

Richard E. Olson: associate professor of finance, University of Alabama.

Van D. Ooms, Yale University: associate professor of economics, Swarthmore College.

Joseph M. Ostroy: acting assistant professor of economics, University of California, Los Angeles.

Jong-Heum Park: assistant professor of economics, North Dakota State University.

Prasanta K. Pattanaik, University of Delhi: assistant professor of economics, Harvard University.

Rein Peterson, University of Western Ontario: associate in business, Graduate School of Business, Columbia University, spring 1969.

Paul A. Phillips: visiting assistant professor, department of economics and commerce, Simon Fraser University.

Alberto M. Piedra: associate professor of economics, Catholic University of America.

Richard D. Porter, University of Wisconsin: assistant professor of economics, Ohio State University.

Barry L. Prince: assistant professor of economics, California State College at Hayward.

Henry O. Pruden: acting assistant professor, department of marketing, insurance and transportation, College of Business Administration, University of Oregon.

Frank W. Puffer, University of California, Los Angeles: associate professor of economics, Clark University.

Allan G. Pulsipher, Texas A&M University: assistant professor, Southern Illinois University.

Malcolm J. Purvis, Michigan State University and University of Nigeria: assistant professor of agricultural economics, University of Minnesota—overseas assignment, AID, Tunisia 1968-70.

Frederick B. Putney, Stanford University: associate in business, Graduate School of Business, Columbia University.

David H. Pyle: acting assistant professor of business administration, University of California, Berkeley.

David Qualls: assistant professor of economics, University of Maryland.

Sol Rabin: acting assistant professor of real estate and urban land economics, University of California, Los Angeles.

K. Phillip Rahbany: professor of economics, Texas A&M University.

David W. Rasmussen, Washington University: assistant professor, Florida State University.

Jon A. Rasmussen: lecturer in economics, Wesleyan University.

Donald Ratajczak: acting assistant professor of business economics, University of California, Los Angeles.

Jakob Rauber, Johns Hopkins University: assistant professor of economics, University of Connecticut.

J. David Reed: assistant professor of economics, Bowling Green State University.

Idrian N. Resnick, Princeton University: assistant professor, Columbia University, 1968-69.

Rudolf Rhomberg: visiting professor of economics, Yale University.

Charles E. Richter: assistant professor of economics, University of North Carolina.

Rodney P. Romig: instructor in economics, North Dakota State University.

Arthur M. Ross, University of California, Berkeley: professor of economics, University of Michigan.

John W. Rowe Jr.: associate professor of economics, University of Houston.

Frederick H. Rueter: assistant professor of economics, Virginia Polytechnic Institute.

Nancy Ruggles, Yale University: senior research staff, National Bureau of Economic Research.

Richard Ruggles, Yale University: senior research staff, National Bureau of Economic Research.

Francis W. Rushing: assistant professor of economics, University of Georgia.

William R. Russell, Michigan State University: associate professor of economics, University of Kentucky.

- Michael Ryan: assistant professor of economics, University of South Carolina.
- John K. Ryans Jr.: associate professor of business administration, University of Kentucky.
- Donald E. Saleh, Claremont Graduate School: assistant professor, California State College at Long Beach.
- Thomas R. Saving: professor of economics, Texas A&M University.
- Jerome E. Schnee, Drexel Institute of Technology: associate in business, Graduate School of Business, Columbia University, spring 1969.
- Peter Schulkin: instructor, Boston College.
- Aba Schwartz, University of Chicago: assistant professor of economics, Ohio State University.
- Hugh Schwartz, Yale University: assistant professor of economics, Case Western Reserve University.
- Stuart A. Schweitzer, Brookings Institution and University of Minnesota: assistant professor of economics, University of Kentucky.
- Tibor Scitovsky: professor of economics, Yale University.
- Thomas T. Sekine, Simon Fraser University: assistant professor of economics, York University, Toronto.
- Edward Shaffer: assistant professor of economics, Occidental College.
- Karl Shell, Massachusetts Institute of Technology: associate professor of economics, University of Pennsylvania.
- Douglas D. Shetler: acting assistant professor of economics, University of California, Los Angeles.
- William A. Shrode: acting assistant professor, department of personnel and industrial management, College of Business Administration, University of Oregon.
- Robert Silberzweig: instructor, Boston University.
- Julian L. Simon: associate professor of economics and marketing, University of Illinois.
- Frank Smith, University of Massachusetts: Traveler's Research Center, Hartford.
- James D. Smith: associate professor of economics, Pennsylvania State University.
- Janet R. Smith: instructor, department of economics and commerce, Simon Fraser University.
- Paul Smith: professor of economics, University of Missouri.
- Vernon L. Smith: visiting professor of economics, University of Massachusetts, 1968-69.
- Donald C. Snyder: instructor in economics, Miami University, Middletown.
- Peter M. Sommerhauser: instructor in economics, University of Nebraska.
- Hugo Sonnenschein: visiting professor of economics, Pennsylvania State University, 1968-69.
- Duane Sorenson: assistant professor of economics, Indiana State University.
- Peter O. Steiner, University of Wisconsin: professor of economics, University of Michigan.
- Robert Stewart: assistant professor of economics, Douglass College, Rutgers—The State University.
- Richard T. Stillson: assistant professor of economics, Ohio State University.
- James A. F. Stoner, Massachusetts Institute of Technology: assistant professor, Graduate School of Business, Columbia University.
- Peter S. Stowe, Purdue University: assistant professor, Southern Illinois University.
- John L. Stromberg; staff member, economics department, The RAND Corporation, June 1967.
- Berkhard Struempel, German Science Foundation: associate professor of economics, University of Michigan.
- W. Craig Stubblebine: associate professor of economics, Claremont Men's College, after a year at the University of Turin.

Philip Swan: assistant professor, Boston University.

Richard J. Sweeney: acting assistant professor of economics, University of California, Los Angeles.

Takashi Takayama, University of New England, Armidale, New South Wales, Australia: professor of economics and agricultural economics, University of Illinois.

Kenji Takeuchi: economist, International Bank for Reconstruction and Development, Washington, D.C.

James R. Taylor, University of Wisconsin: assistant professor of economics, New Mexico State University.

Lester Taylor, Harvard University: associate professor of economics, University of Michigan, winter 1969.

William Taubert: assistant professor of operations management, University of California, Los Angeles.

Earl A. Thompson: visiting associate professor, University of Southern California, 1968-69.

Paul Thompson: assistant professor of economics, Texas A&M University.

Wilbur Thompson, Wayne State University: visiting professor of economics, University of Michigan.

Lester C. Thurow, Harvard University: Massachusetts Institute of Technology.

Maurice Townsend: visiting assistant professor, Washington University.

William P. Travis, Massachusetts Institute of Technology: associate professor of economics, University of California, San Diego.

George Treyz, Haverford College and Bryn Mawr: assistant professor of economics, University of Massachusetts.

Che S. Tsao, George Washington University: assistant professor of economics, University of Massachusetts.

Gordon Tullock, Rice University: professor of economics and collective choice, Virginia Polytechnic Institute.

Stephen Turnovsky, Harvard University: assistant professor of economics, University of Pennsylvania.

Milford S. Tysseland: associate professor, department of finance and insurance, University of Florida.

Charles Upton: instructor in business economics, Graduate School of Business, University of Chicago.

Paul Uselding, Northwestern University: instructor, University of Illinois.

Firouz Vakil: acting assistant professor of economics, University of California, Los Angeles.

T. Norman Van Cott: assistant professor of economics, University of New Mexico.

René Vandendries, Iowa State University: assistant professor, University of Illinois.

William M. Vaughn III: instructor in industrial relations, Graduate School of Business, University of Chicago.

Stanley S. Wallack, Washington University: instructor, University of Illinois.

Irwin J. Wargon, University of California, Los Angeles: assistant professor, California State College at Long Beach.

James Warren: assistant professor of finance, University of California, Los Angeles.

Warren E. Weber: assistant professor of economics, Virginia Polytechnic Institute.

John F. Weeks: assistant professor of economics, Wayne State University.

Eliot R. Weintraub: lecturer in economics, Rutgers College, Rutgers—The State University.

Thomas Weisskopf, Indian Statistical Institute: assistant professor of economics, Harvard University.

Porter K. Wheeler: lecturer in economics, Wesleyan University.

Kenneth Wickman, University of Massachusetts: associate professor of economics, State University of New York at Cortland.

Edward Wiegner: assistant professor of economics, Marquette University.

Albert P. Williams: staff member, economics department, The RAND Corporation, June 1967.

Edward E. Williams: assistant professor of economics, Rutgers College, Rutgers—The State University.

Sidney Winter: professor of economics, University of Michigan.

Claus Wittich: visiting assistant professor of economics, University of Southern California, 1968-69.

Alexander Woroniak: associate professor of economics, Catholic University of America, Sept. 1, 1967.

Shih C. Yu: professor of accounting, University of Florida.

Joseph R. Zecher: assistant professor of economics, University of Chicago, fall 1966.

Burton Zwick: acting assistant professor of finance, University of California, Los Angeles.

### *Leaves for Special Appointments*

F. Gerard Adams, University of Pennsylvania: Council of Economic Advisers, Washington, D.C.

Armen A. Alchian, University of California, Los Angeles: Ford Foundation Distinguished Visiting Professor, Graduate School of Business, University of Chicago.

Thomas J. Atchison, San Diego State College: visiting professor, University of Minnesota, 1968-69.

William L. Baldwin, Dartmouth College: visiting professor of economics, Thammasat University, Bangkok.

Jere R. Behrman, University of Pennsylvania: Center of International Studies, Santiago, Chile.

Calvin R. Berry, University of Arkansas: visiting professor of agricultural economics, University of Minnesota.

Calvin P. Blair, University of Texas: Ford Foundation program adviser in social sciences for Mexico and Central America, Mexico City, June 1968-Feb. 1970.

John M. Brazzel, University of Missouri: Harvard-M.I.T. Joint Center for Urban Studies, 1968-69.

Kenneth M. Brown, Ohio State University: economic policy fellowship, Brookings Institution.

Hang-Sheng Cheng, Iowa State University: consultant in taxation, Government of the Republic of China, Taiwan, 1968-1969.

Benjamin Cohen, Harvard University: deputy director, Plans, Programs, and Evaluation Staff, Office of Metropolitan Development, Department of Housing and Urban Development, Washington.

Frank Falero Jr., Virginia Polytechnic Institute: Fulbright visiting lecturer, Universidad de Peru, Lima.

John U. Farley, Carnegie-Mellon University: visiting associate professor, Graduate School of Business, Columbia University.

Philip L. Gamble, University of Massachusetts: visiting professor of economics, Naval War College, Newport, Rhode Island.

Raymond R. Gamby, University of Pittsburgh: head, department of business administration, Institute of Administration, Ahmadu Bello University, Zaria, Nigeria under University of Pittsburgh contract with AID, 1968-70.



S. Malcolm Gillis, Duke University: Harvard University Development Advisory Service, Colombia, first semester 1968-69.

Arthur S. Goldberger, University of Wisconsin: Keynes visiting professor of economics, University of Essex, 1968-69.

Robert Hartman, Brandeis University: economic policy fellowship, Brookings Institution.

A. J. Heins, University of Illinois: Institute of Poverty, University of Wisconsin, 1968-69.

W. Whitney Hicks, University of Missouri: post-doctoral student and visiting lecturer, University of Pennsylvania, 1968-69.

Vaclav Holesovsky, University of Massachusetts: director of University of Massachusetts Overseas Study Program, University of Freiburg.

Jerome J. Hollenhorst, Southern Illinois University: visiting professor for research, Federal Reserve Bank, Minneapolis.

Holland Hunter, Haverford College: visiting lecturer in economics, University of Pennsylvania.

Raymond Jackson, Boston University: visiting professor, University of Rochester.

Clinton E. Jencks, San Diego State College: scholar-in-residence, University of Colorado.

Lamar B. Jones, Louisiana State University: Fulbright-Danforth visiting lecturer, Bangalore University, India.

David Klahr, University of Chicago: University of Stirling, Scotland, June-December 1968; Fulbright lecturer, London Graduate School of Business Studies, January-June 1969.

Ramon Knauerhase, University of Connecticut: economic consultant, Ford Foundation, Saudi Arabia, 1968-69.

Arlyn J. Larson, Arizona State University: consultant, Arizona Department of Property Valuation and Ways and Means Committee, Arizona House of Representatives, summer 1968.

Herbert S. Levine, University of Pennsylvania: Fulbright-Hays fellowship, London School of Economics and University of Moscow.

Raymond Lubitz, Columbia University: Chamberlin Fellow, fall 1968.

Richard Martin, University of Massachusetts: acting head, department of economics, University of Hartford, 1968-69.

Peter F. M. McLoughlin, University of Santa Clara: director of economics, East African Development Bank, Kampala, Uganda, 1968-70.

Charles W. Meyer, Iowa State University: visiting professor, University of Wisconsin, 1968-69.

Jimmie R. Monhollon, Federal Reserve Bank of Richmond: visiting associate professor of economics, University of Illinois, 1968-69.

James L. Murphy, University of North Carolina: visiting professor, Thammasat University, Bangkok.

Vern E. Odmark, San Diego State College: visiting professor, Ohio State University, 1968-69.

David J. Ott, Southern Methodist University: staff, President's Council of Economic Advisers, 1968-69.

Edmund S. Phelps, University of Pennsylvania: visiting professor, Brookings Institution.

Robert A. Pollak, University of Pennsylvania: Bureau of Labor Statistics, Washington, D.C.

Russell G. Pounds, Iowa State University: director, Des Moines Model Cities Project, Des Moines, June 1968-January 1969.

Paul C. Roberts, Virginia Polytechnic Institute: Oxford University, July 1968-1969; visiting associate professor of economics, Tulane University, January-June 1969.

Richard N. Rosett, University of Rochester: National Council Chair Professorship, National Taiwan University, Taipei, 1968-69.

Martin Segal, Dartmouth College: economics branch, International Labor Office, Geneva.

George P. Schultz, University of Chicago: fellow, Center for Advanced Studies in the Behavioral Sciences, Stanford, California.

Werner Sichel, Western Michigan University: Fulbright visiting lecturer, University of Belgrade, Yugoslavia, 1968-69.

Morris Singer, University of Connecticut: resident research professor, Hacettepe University, Ankara.

Warren Smith, University of Michigan: Council of Economic Advisers, 1968-69.

Delbert A. Snider, Miami University: European Study Center, Miami University, Luxembourg, 1968-69.

Wayne Snyder, OECD: Center for Research on Economic Development, University of Michigan, 1968-69.

Harold K. Strom, University of Oregon: exchange professor, The Netherlands N.O.I.B., Breukelen, 1968-69.

Frank E. Wagner, University of Missouri, Kansas City: Fulbright professor, University of Guadalajara, Guadalajara, Mexico, 1968-69.

Stanislaw Wellisz, Columbia University: Wesley Clair Mitchell Research Professor, 1968-69.

William G. Whitney, University of Pennsylvania: visiting assistant professor of economics, Exeter University, England.

### *Resignations*

William Abernathy, University of California, Los Angeles, July 1968.

Johan Arndt, Graduate School of Business, Columbia University, July 1968.

Gulford C. Babcock, University of California, Berkeley, July 1968.

Nicholas Baloff, Graduate School of Business, University of Chicago, September 1968.

David Barkin, Washington University, June 1968.

Frederick W. Bell, Clark University.

Marvin Berhold, California State College, Los Angeles.

Eugene P. Brigham, University of California, Los Angeles, July 1968.

Joel S. Demski, Graduate School of Business Columbia University, July 1968.

Stanley Diller, Graduate School of Business, Columbia University July 1968.

David C. Freytag, University of Cincinnati.

Verne V. Gilbert, School of Business Administration, San Diego State College, September 1968.

Melvin N. Greenball, University of California, Berkeley, July 1968.

Carl C. Greer, Graduate School of Business, Columbia University, July 1968.

William P. Huenefeld, Yale University.

Nuri T. Jazairi, York University, Toronto.

Walter J. Klages, University of Alabama, July 1968.

Sidney Klein, Rutgers College, Rutgers—The State University, June 1968.

John M. Kohlmeier, Graduate School of Business, University of Chicago, October 1968.

Millard Long, Graduate School of Business, University of Chicago, July 1968.

Shah Mahmoud, Rutgers College, Rutgers—The State University, June 1968.

Jesse W. Markham, Princeton University, September 1968.

Richard W. Massey, University of Alabama, June 1968.

Manning Nash, Graduate School of Business, University of Chicago, October 1968.

David M. O'Neill, University of Pennsylvania, July 1968.

Johann ~~Reich~~ Miami University, Middletown, June 1968.

Arvo Ray, York University, Toronto.

Ali Raza, University of California, Los Angeles, July 1968.

Daniel Remington, College of Business Administration, University of Oregon, fall 1968.

Thomas Robertson, University of California, Los Angeles, July 1968.

James W. Robinson, University of South Carolina.

Charles S. Rockwell, Yale University.

Morton Schnabel, California State College, Los Angeles

Richard Schramm, Graduate School of Business, Columbia University, July 1968.

Alvin J. Silk, Graduate School of Business, University of Chicago, July 1968.

Eugene Smolensky, Graduate School of Business, University of Chicago, October 1967.

Douglas O. Stewart, Miami University, August 1968.

Charles E. Summer, Graduate School of Business, Columbia University, July 1968.

James E. Willis, University of Houston.

Montague Yudelman, University of Michigan.

### *Miscellaneous*

Robert A. Kavesch, Graduate School of Business Administration, New York University, has been awarded the E. Harris Harbison Prize of the Danforth Foundation for "distinguished teaching."

Theodore Marburg, Marquette University, has been awarded the Marquette Award for Teaching Excellence.

Jacob Marschak, emeritus professor of business administration and economics, recalled to active duty as director, Western Management Science Institute, University of California, Los Angeles.

### *Program, 1969 Annual Meeting*

Suggestions from members of the American Economic Association for topics to be included in the program of the 1969 annual meetings—with names of proposed authors and discussants—are invited by the program committee.

Such suggestions should be sent as soon as possible, but not later than January 1, 1969, to Professor Wassily Leontief, Room 309, Littauer Center, Harvard University, Cambridge, Mass. 02138.

## SIXTY-FIFTH LIST OF DOCTORAL DISSERTATIONS IN POLITICAL ECONOMY IN AMERICAN UNIVERSITIES AND COLLEGES

The present list specifies doctoral degrees conferred during the academic year terminating June 1968. Abstracts of many of the dissertations are supplied.

### General Economics; Methodology

WARREN L. RITTSCHOF, Ph.D. Illinois 1968. The high school economics course: a scientific approach.

### Price and Allocation Theory; Related Empirical Studies

MASAHITO AOKI, Ph.D. Minnesota 1967. Increasing returns to scale and market mechanisms.

The first part of the paper discusses the technological possibilities of an economy subject to increasing returns in the framework of a statistical model of industrial interdependencies. The second part deals with the problem of achieving an optimal mode of production in the presence of external economies of scale through market mechanisms. A formula of an optimal tax-subsidy scheme for such an economy is given.

ROBERT L. AVINGER, JR., Ph.D. Duke 1968. The economics of durability.

MEYER W. BELOVICZ, Ph.D. Purdue 1967. The sealed bid auction: experimental studies.

ROGER D. BLAIR, Ph.D. Michigan State 1968. Inferior inputs and external effects.

This thesis explores the implications of inferior inputs on the solutions to the resource misallocation problem created by external effects. To this end, the concepts of external effects and inferior inputs are systematically developed in separate chapters. Then a situation is hypothesized in which an inferior input causes an external diseconomy. The solutions for removal of the Pareto relevance of this external diseconomy are subsequently analyzed. This analysis reveals that the solutions are unaffected by the influence inferiority.

FREDERICK CLEVELAND, Ph.D. Columbia 1968. Resource allocation in the firm.

Managers must allocate resources to such intangible sectors as research and development, marketing, manpower, as well as to tangible sectors. There is no operational theory for solving these problems of resource allocation over time when there is uncertainty about costs and revenues. The use of a simulation model of the firm, flexible enough to accept a wide variety of heuristic decision rules, is proposed, in order to explore the relative effectiveness of decision rules under a variety of conditions and to compare alternative allocations. Such a model, incorporating research and development investments, was constructed. Methods of analysis of data and changes are demonstrated. Limitations of the methodology are discussed, and other areas of applicability are suggested.

JAMES T. GODFREY, Ph.D. Michigan 1967. Resource allocation in the short- and long-run—an application of linear and recursive programming.

REUBEN GRONAU, Ph.D. Columbia 1967. The effect of traveling time on the demand for passenger airline transportation.

The price of a trip consists of two parts: the fare and the opportunity cost of time. The opportunity cost of time depends on the trip's elapsed time and the traveler's price of time, which, in turn, varies with the traveler's income and purpose of trip. Estimating the demand function it is found that the income elasticity exceeds unity, the price elasticity is less than unity, and the price of time is 40 per cent of the hourly wage rate.

JON T. INNES, Ph.D. Oregon 1967. The role of capacity utilization in the investment decision.

JON M. JOYCE, Ph.D. Northwestern 1967. Sales anticipations and inventory investment.

A model of firm behavior is used to analyze the effects on inventory investment of changes in sales anticipations, cost of capital and liquidity, the cost of adjustment and errors in anticipations. This model forms the basis for equations estimated with time series and cross sections of the same large body of individual firm data.

SHAUL P. LADANY, Ph.D. Columbia 1968. Maximization of revenue from sale of United Nations stamps for philatelic purposes.

An attempt to analyze the behavior of the United Nations philatelic postage-stamps market has been performed in order to gain knowledge of the mechanism relating the various decision parameters influencing the postal administration's profit. The obtainable revenue from a new set of stamps, and the variables determining the market price of an existing set were determined. Both were incorporated into the yearly revenue maximizing model, obtaining the necessary issuing policy requirements. This systematic method, developed here, might be adapted for maximization of revenue from sale of stamps of different countries, sale of coins, medals and artistic engravings.

BERTRAND E. LANOUE, Ph.D. Saint Louis 1968. Analysis of the factors which affect the investment decision: a case study.

ROBERT L. LAWSON, Ph.D. Iowa 1967. The theory of games and bilateral monopoly.

JOHN O. LEDYARD, Ph.D. Purdue 1968. A convergent Pareto—satisfactory non-tatonnement adjustment process for a class of unselfish exchange environments.

GEBHARD LONG, Ph.D. Oregon 1967. Separable utility and the estimation of demand elasticities.

YAO-CHI LU, Ph.D. Iowa (Ames) 1967. Variable elasticity of substitution production functions, technical change and factor shares.

MICHAEL LYNCH, Ph.D. Chicago 1967. The expected utility hypothesis and the demand for insurance.

The thesis is devoted to exploring the relation between risk aversion and expenditure on insurance. It is shown that it is generally rational to "underinsure" and that the extent of underinsurance is largely a function of the extent of risk aversion. We give necessary and sufficient conditions for a rational individual to always spend a constant proportion of his wealth on insurance and then derive explicit demand functions for this case. These demand functions are tested against data on life insurance purchases and are found to be consistent with the data.

RICHARD J. OLSEN, Ph.D. Rutgers 1967. Some aspects of quality change as an economic variable.

Since quality may be as significant as quantity in determining the welfare of society, this study attempts a systematic examination of quality change as an economic variable. Quality change is shown to be related to recent explanations of unemployment, inflation, and economic growth. The major problems of quality change measurements are specified and potential solutions are proposed and illustrated. These procedures are compared with the present treatment of quality change in the Consumer Price Index.

N. S. REVANKAR, Ph.D. Wisconsin 1968. Production functions with variable elasticity of substitution and variable returns to scale.

ANNE G. SARNDAL, Ph.D. North Carolina 1968. Optimum price and investment criteria.

The dissertation considers price within the framework of alternative investment criteria. First and second order conditions are derived for a general criterion and interpreted for the criteria under discussion. Several illustrative examples are given in order to compare the resulting output with the traditional profit-maximizing output.

NICHOLAS SCHROCK, Ph.D. Oregon 1967. A portfolio analysis of straddle operations in the futures markets: an application of the expected returns variance of returns hypothesis.

AMMAR SIAMWALLA, Ph.D. Harvard 1967. General equilibrium analysis of imperfect competition.

An existence proof for a basic general equilibrium model which differs from the Arrow-

Dereu model in that price is no longer a parameter for the firm. The basic model is a generalization of a model proposed by Negishi. It can be generalized to cover many types of market systems.

CHRISTOPHER A. SIMS, Ph.D. Harvard 1968. The dynamics of productivity change: a theoretical and empirical study.

The thesis develops the "capacity-vintage hypothesis," which includes existing vintage models of production as special cases, yet allows for more than one type of fixed output. A continuous-time stochastic model shows that the capacity vintage hypothesis implies a dynamic relation between output and productivity, and that this relation can be used to estimate the average proportional gap between best-practice and average productivity. Application to geographical cross section within U.S. 2-digit level manufacturing industries supports the theory.

DAVID A. STARRETT, Ph.D. Stanford 1968. Contributions to the theory of capital in infinite time horizon models.

In this dissertation the efficiency of perfect competition is discussed for a model in which the number of commodities is arbitrary and there is no finite time horizon. Along balanced growth programs it is shown that interest rates below the growth rate correspond to inefficient competitive programs in both a production model of the Malinvaud type and a distribution model of the "consumption loans" type. Under certain restrictive conditions on the technology, however, it is shown that competitive inefficiency cannot occur.

FRITS J. E. TAN, Ph.D. Syracuse 1967. On polarity in economics.

STEPHEN J. TURNOVSKY, Ph.D. Harvard 1968. Consumer behavior under conditions of uncertainty in supply.

Uncertainty in supply of commodities experienced by individuals can take different forms depending on price flexibility in the market, and in this thesis several such behavioral models are constructed. In each model the individual's consumption plans are derived as functions of prices; income as well as parameters describing the probability distribution of supply and responses to parameter changes are studied. These parameters can frequently be controlled by the government. How they should be optimally determined is considered and finally some empirical verification of earlier work is performed.

JOHN T. WENDERS, Ph.D. Northwestern 1967. The growth and diversification of the firm.

### Income Theory; Related Empirical Studies

CHARLES W. BISCHOFF, Ph.D. Mass. Inst. Technology 1968. A study of distributed lags and business fixed investment.

This study is directed toward the problem of determining both the quantitative magnitude and the temporal structure of the effects of fiscal and monetary policies on expenditures for durable capital goods. The standard formulation of the neo-classical model is criticized for the restrictive nature of the assumptions which have been added to make possible statistical estimation. A more general set of restrictions is developed and used. The more general model provides a much better explanation of aggregate time series for the postwar period.

RAFORD D. BODDY, Ph.D. Michigan 1968. Interactions among vintage investments in aggregate production functions.

GEORGE D. CRAIG, Ph.D. Illinois 1968. Predictive accuracy of aggregate quarterly and annual saving functions.

This study uses several measures of predictive accuracy in searching for best forecasters of saving in postwar periods. The most important basic findings are: (1) the more dynamic saving functions (designated as Normal Income and Habit Formation Models) do best overall; (2) predictive accuracy is consistently increased when saving includes expenditures on durables, except depreciation; and (3) the addition of asset variables improves predictive accuracy with annual data but makes it worse with quarterly data.

ERIC G. DAVIS, Ph.D. Brown 1968. Optimal savings policy when labor grows endogenously.

This thesis studies optimality when the growth rate of population responds to economic factors in particular to per capita income. It is found that Phelps' Golden Rule of Accumulation is no longer optimal: the marginal productivity of capital should exceed the growth rate of the economy. If "total" utility is being maximized over an infinite time horizon, endogenous population growth both brings new emphasis to the form of the utility function and imposes restrictions on the form that society chooses. Further modifications are also considered: a control variable directly influencing population, technical change and optimal education costs are introduced.

NOEL M. EDELSON, Ph.D. Yale 1967. Selected problems in the theory of investment demand.

RAY C. FAIR, Ph.D. Mass Inst. Technology 1968. The short run demand for employment.

Two models are developed, one of the short run demand for the number of production workers employed and the other of the short run demand for the number of hours paid for per production worker. From these two models the short run demand for total man-hours paid for can be derived. The basic equations of the model are estimated, and the results are compared with results of estimating equations of various alternative models. Using the model developed in this study as a base, various hypotheses regarding short run employment demand are developed and tested.

JOHN M. HORNBY, Ph.D. Mass Inst. Technology 1967. Savings and development.

Because urban income is a better tax base than agricultural income, savings considerations indicate that the share of national income that is earned in urban areas should be increased by increasing the price of industrial consumer goods relative to that of food. This in turn involves a program of heavy investment in agriculture, so as to increase the supply of food relative to that of industrial consumer goods. This basic macro-economic mechanism is incorporated in a general equilibrium model and a set of dual prices for savings is derived which are then used resources.

AXEL LEIJONHUFVUD, Ph.D. Northwestern 1967. On Keynesian economics and the economics of Keynes: a study in monetary theory.

For a summary of contents, cf. the author's "Keynes and the Keynesians: A Suggested Interpretation," *American Economic Review*, May 1967, and "Keynes and the Effectiveness of Monetary Policy," *Western Economic Journal*, March 1968.

JOSEF MAY, Ph.D. Chicago 1968. An adjustment mechanism based on anticipations in a macro-economic model.

A dynamic macro-economic model is constructed. The dynamic element is introduced through anticipations: behavior depends not only on the current value of some variables, but also on their anticipated future level and future rate of change. Anticipations are formed according to rules that are a generalization of the adaptive expectations model. This dynamic model generates the adjustment path of prices, interest rates, employment and output of external disturbances, such as fiscal and monetary policy.

TIMOTHY W. MCGUIRE, Ph.D. Stanford 1968. An empirical investigation of the U.S. manufacturing production function in the post-war period.

Various CES and "nested" CES functions of capital, production labor, and non-production labor are estimated, either indirectly with errors-invariables estimating techniques or directly by nonlinear ordinary least squares. While the estimates of the substitution elasticities are sensitive to model specification, there is, unfortunately, little basis for choosing among competing specifications. The behavior of short-run labor productivity is examined, and implications for the Wage and Price Guideposts are discussed.

DONALD A. NICHOLS, Ph.D. Yale 1968. Growth and unemployment in the United States: 1947-1964.

DAVID H. NISSEN, Ph.D. California (Berkeley) 1968. Policy in a dynamic neoclassical economy.

RAMACHANDRA RAMANATHAN, Ph.D. Minnesota 1967. An econometric exploration of Indian saving behavior.

The study consists of two parts. The first part examines the effect on saving of household income and net worth for about 500 Indian households. The saving behavior of socio-

economic groups based on occupation, home-ownership, age, education, etc., have also been studied. The second part studies alternative criteria for measuring "permanent income." A procedure is suggested to estimate expected future receipts from cross section data, which is then used to estimate permanent income.

LARRY E. RUFF, Ph.D. Stanford 1968. Optimal growth and technological progress in a Cournot economy.

This paper discusses the question of industrial organization and technological progress in a special, abstract model. Using the methods of optimal control theory, the socially optimal program of research is compared to the programs resulting from private maximization by  $N$  identical, generalized Cournot competitors, with various institutions for encouraging research. Also, the adoption of embodied, externally supplied innovations is studied, and the effect of industrial organization discussed.

JOHN K. STEPHENS, Ph.D. Illinois 1967. Differentiation of labor in macroeconomic growth models.

Labor is assumed to be non-homogenous through division into two categories (with and without educational transformation between categories) or through considering education as a kind of capital. The effects of this assumption on the Harrod-Domar, Cobb-Douglas, Samuelson Interaction, Kendrick and Sato, and simple Keynesian models are investigated. New models in which labor is assumed to have vintages of increasing educational quality are presented, including an extension of Massell's capital vintage model.

HIROKUNI TAMURA, Ph.D. Michigan 1967. Linear models for macroeconomic policy making.

SAMUEL H. WILLIAMSON, Ph.D. Purdue 1968. A quantitative test of a three market IS-LM model.

### History of Economic Thought

MARIAN V. NOORDAM, Ph.D. Alabama 1967. The purpose, scope and content in college textbooks in economics, 1900-1960: a study of early editions of selected American writers.

A survey of selected textbooks divided into four time periods, analyzing the approach of sixteen American writers to the presentation of basic economic principles, together with their definition of "economics," reliance upon earlier schools of thought, and incorporation of new methodology and theoretical constructs into elementary texts. The scope and content of each work is compared and reviewed in an historical perspective to illustrate the impact of current events on such writings.

ZOLTAN SEBESTYEN, Ph.D. Columbia 1968. Jeremy Bentham on entrepreneurship, human capital, and economic development.

The object of this study is a systematic presentation and assessment of Bentham's thought on social innovations, with a special emphasis on the function of the entrepreneur in the economy.

CHARLES H. SHAMI, Ph.D. Columbia 1968. Charles Ellet, Jr., early American economic theorist and econometrician 1810-1862: an analytical exposition of his theories.

HERMAN A. STRIBLING, JR., Ph.D. Alabama 1967. Diego Saavedra Fajardo and Spanish mercantilism.

### Economic History; Economic Development; National Economies

JOHN W. ALLEN, Ph.D. Illinois 1967. Illinois interregional product flows.

Study estimates extent of Illinois manufacturing and wholesale trade with nine United States and five foreign regions during 1963. The estimates, derived from a mailed survey, are presented in a set of "from-to" tables cross-classifying the regional origin of products used by the regional destination of products shipped. Coefficients of interregional interdependence are also estimated. Estimated trading patterns are analyzed and found generally consistent with accepted theory. Data are fitted to the gravity model with varying success.



DORRA ALWAN, Ph.D. Wisconsin 1967. An analysis of investment criteria in the Reports of the International Bank for Reconstruction and Development Missions.

EDWARD A. AROWOLO, Ph.D. McGill 1968. The problems of investment allocation in planned economic development: with special reference to Nigeria.

This thesis examines the problems associated with the application of investment criteria to planning in developing countries, with particular reference to Nigeria. Investment criteria usually prescribed in the literature are critically evaluated. The study shows that a modified social marginal productivity (SMP), embodying the total effectiveness of capital in contributing to stated objectives of development and quantified through the use of shadow prices (to reflect the current and expected scarcities, of capital, labour and foreign exchange), is suitable for application.

PETER BELL, Ph.D. Wisconsin 1968. The role of the entrepreneur in economic development—a case study of Thailand.

The principal findings of this study are that a definition of entrepreneurship that relates innovative actions to observable economic phenomena provides a framework for examining the role of entrepreneurs in economic development, and that systematic and identifiable relationships appear to exist between numbers of entrepreneurs and aspects of the social and economic environment, in particular the economic incentives provided to entrepreneurs. These findings were arrived at by a review of the methodologies and conclusions of existing studies of entrepreneurs, by the use of quantitative techniques to reveal interrelationships between a range of variables, and by a sample survey of entrepreneurs in the modern manufacturing sector in Thailand. The study stresses the need to bring entrepreneurial growth within the range of policy control and provides a critical assessment of market incentives as an adequate force for economic growth.

ROBERTO M. BERNARDO, Ph.D. California (Berkeley) 1967. Central planning in Cuba: ideology, structure, and performance.

SARA S. S. BERRY, Ph.D. Michigan 1967. Cocoa in Western Nigeria, 1890-1940. A study of an innovation in a developing economy.

PHILLIP J. BRYSON, Ph.D. Ohio State 1967. The international cost-sharing role of West German development assistance.

This investigation of the cost-sharing implications of West Germany's development assistance (1) draws from the economic literature on international burden-sharing for possible criteria of "fairness," and (2) suggests and develops additional criteria such as participation in alliance "mutual security" projects, foreign trade policies designed to favor the developing countries, and "contributive capacity." The analysis takes a cost-benefit framework and attempts to determine the nature of the relationships between German aid and the related considerations mentioned.

THOMAS BURKE, Ph.D. Wisconsin 1968. An evaluation of investments in tin or alternative projects on the future foreign exchange earnings of Bolivia.

The focus was to determine whether the major export from Bolivia, tin, presented the best alternative for earning additional foreign exchange. Twenty projects in mining and other potential exports were analyzed and ranked using two criteria applied sequentially, the net discounted foreign exchange receipts and the net discounted total receipts. The results indicated the necessity for selecting on a basis of individual projects rather than a general policy.

JOSEPH BURNS, Ph.D. Oregon 1967. Financial intermediaries and economic growth in Venezuela.

THOMAS N. CHIRIKOS, JR., Ph.D. Ohio State 1967. Bolivia: a case study in the theory and practice of human resource planning.

SOON CHOUGH, Ph.D. California (Berkeley) 1967. Financing of economic development in South Korea, 1954-1964.

PETER B. CLARK, Ph.D. Mass. Inst. Technology 1967. The choice of optimal import substitution patterns for Nigeria.

The objective of this study is to evaluate the impact of alternative patterns of import substitution on the Nigerian economy by use of a linear programming model formulated

to investigate the performance of the economy under alternative resource constraints. The framework of the model provides a comprehensive tool for choosing efficient programs of investment using a consistent set of endogenously determined shadow prices as part of an investment criterion which is very similar to the most comprehensive evaluation technique.

ROBERT E. COLE, Ph.D. Northwestern 1967. The Liberian elite as a barrier to economic development.

NELSON B. CRICK, Ph.D. Colorado 1967. Obstacles to industrial entrepreneurship in an underdeveloped country: a case study of Egypt before 1952.

RAMZI A. DALLOUL, Ph.D. Columbia 1968. Gap analysis, an intertemporal mathematical programming approach: the case of the United Arab Republic.

ASHOK K. DAR, Ph.D. Cornell 1967. Domestic terms of trade and economic development in India.

VICTOR P. DIEJOMAOH, Ph.D. Harvard 1968. Financing development expenditures: the Nigerian experience since 1950.

This dissertation studies the major sources of development financing in Nigeria during the post-1950 period. A quantitative analysis of the 1950-65 period and a "three gap" analysis of future developmental possibilities lead to a thesis that the shortage of domestic savings now exists and is likely to remain the most limiting economic factor in further Nigerian development. Much effort is therefore devoted to finding ways of increasing development finance sources in the future.

AVINASH DIXIT, Ph.D. Mass. Inst. Technology 1968. Development planning in a dual economy.

The important economic problems facing a dual economy include those of allocation of investment and choice of technique, and the marketable surplus problem. Technological and institutional constraints and requirements for growth lead to solutions which differ from the classical static solutions. The thesis analyzes some theoretical implications of this situation for development planning.

JAMES H. DUKES, Ph.D. Florida 1968. Monetary and fiscal policies of Brazil 1953-1963.

The institutional structure is presented in detail to show long-range national strengths and limitations evident in the pursuit of economic goals. Study is made of the national economic development plans in operation during the subject period. Analysis is made of inflation and its relation to Brazil's structural impediments to growth, in explanation of her subsequent failure to achieve the economic projections made in the development plans.

DEAN S. DUTTON, Ph.D. Michigan State 1968. A model of self-generating inflation: the Argentine case.

The model comprises a system of four equations wherein, (1) the rate of change in prices is related to the rate of monetary expansion, (2) the rate of monetary expansion is related to the rate of increase in the monetary base, (3) the rate of increase in the monetary base is related to rates of deficit expenditure, and (4) the rate of nominal deficit expenditure is related to a previous period's rate of price increase.

MATTHEW D. EDEL, Ph.D. Yale 1968. The Colombian community action program: an economic evaluation.

JOHN A. EISELE, Ph.D. Purdue 1968. Income, wealth, and saving in the south 1850, 1860.

EL SAYED A. EL DALY, Ph.D. Rutgers 1967. An econometric model of growth with reference to the U.A.R.

To explain the workings of the Egyptian economy, an econometric model of growth is built and tested by statistical inference. Emphasis is given to hypotheses, estimation procedures, and problems of specification, distribution assumption and justification of the Least Squares. The equations satisfy identification conditions and assure the absence of autocorrelation, multicollinearity and heteroscedasticity. Parameters are significant and consistent with the results of other models. The structural model is supplemented by a trend growth model.

ZABIUZZAH ELTEZAM, Ph.D. Wayne State 1967. Problems of economic development and resource allocation in Afghanistan.

STEFANO FENOALTEA, Ph.D. Harvard 1968. Public policy and Italian economic development, 1861-1913.

This dissertation examines the impact of public policy on Italian economic growth. The role of industry and industry's time path is discussed and an explanatory model developed. It becomes apparent that policy, particularly tariff and transport policy, had much to do with both the trend and cycle of Italian industrial output, by setting the path of domestic demand, and by making it impossible for domestic industry to transcend the limitations of the domestic market.

ERNESTO FERNANDEZ-HOLMANN, Ph.D. Harvard 1968. Central America: monetary policy, financial stability, and economic development.

JAMES D. FOUST, Ph.D. North Carolina 1968. The yeoman farmer and western expansion of U.S. cotton production.

An attempt to ascertain the role of the small farmer in westward migration in the ante-bellum South using data from the 1850 and 1860 manuscript census schedules. The data suggest that large planters did not lead the migration into the Southwest and that the small farmer was squeezed of better lands *only* in the rich alluvial regions of the Southwest and in the Old South.

DEBORAH S. FREEDMAN, Ph.D. Michigan 1967. The role of consumption of modern durables in a developing economy: the case of Taiwan.

IRVING GERSHENBERG, Ph.D. California (Berkeley) 1967. Alabama, an analysis of the growth of white public education in a southern state, 1880-1930.

CHARLES R. GIBSON, Ph.D. Pennsylvania 1968. The role of foreign trade in Ecuadorian economic development.

The role of the external sector in the economic development of a developing nation, Ecuador, is considered in the framework of the controversy between those economists who see the principal obstacles to growth through trade as primarily external and beyond the control of the developing countries, and those economists who consider that the obstacles are primarily internal to the developing countries. The Ecuadorian experience during the 1945-65 period tends to support the latter position.

STEPHEN M. GILLIS, Ph.D. Illinois 1968. Sales and excise taxes in a developing economy: the Chilean case.

DAVID E. GOODMAN, Ph.D. California (Berkeley) 1967. Industrialization and economic policy in Brazil and the post-war period.

PATRICK J. GORMELY, Ph.D. Duke 1967. The economic development of Uganda with special reference to the 1966-1971 plan.

DOUGLAS H. GRAHAM, Ph.D. Harvard 1968. Regional economic growth in Brazil 1940-1960.

This study first analyzes the sectoral income and labor force distribution by states for 1949, their association with income per capita standings and finally the degree of inter-sectoral inequality among states in 1949. These sectoral distributions are then discussed in the context of regional dualism. The second part of the study establishes and then interprets the regional growth trends from 1940 to 1960, the degree of divergent or convergent growth of income per capita among the states of Brazil and, finally, the role of internal migration within these regional growth trends.

GEORGE D. GREEN, Ph.D. Stanford 1968. Banking and finance in ante-bellum Louisiana (1804-1861): their influence on the course of economic development.

In this economic history of the financial system of ante-bellum Louisiana, primary attention is focused on the chartered banks, and on the years after the mid-1820's. The study moves from an examination of the internal structure of the banking system itself, to its setting in the state and world-wide financial system, its relation to government policy, and finally to the role of the financial system in the fluctuations and developmental patterns in the larger economy.

GERALD A. GUNDERSON, Ph.D. Washington 1967. The social savings of steamships.

JOHN R. HARRIS, Ph.D. Northwestern 1967. Industrial entrepreneurship in Nigeria.

This dissertation has three main parts. Part 1, a theoretical framework for analyzing

entrepreneurship in the context of economic development. The problem of identifying separately supply of and demand for entrepreneurial services is stressed. Part 2 consists of detailed studies of six industries in which Nigerian entrepreneurs play a significant role. Factors affecting the supply of entrepreneurship are analyzed in Part 3. The general approach in Parts 2 and 3 is hypothesis testing.

**WILLIAM HARRIS**, Ph.D. Oregon 1967. The impact of the petroleum export industry on the pattern of Venezuelan economic development.

**ROBERT HIGGS**, Ph.D. Johns Hopkins 1968. Location theory and the growth of cities in the Western prairie region, 1870-1900.

This study investigates, both descriptively and econometrically, the nineteenth-century urbanization of Missouri, Iowa, Kansas, and Nebraska. An economic model of city growth is specified, and testable hypotheses are deduced from it. Multiple regression analysis is used to test the hypotheses. City growth is found to have been strongly related to population growth in the surrounding countryside, and—in contradiction to most historical accounts—only weakly related to the acquisition of railroads.

**JOHN R. KAATZ**, Ph.D. Wayne State 1968. Plant scale requirements for viable economic development; The Delta County, Michigan, case.

**ZIAD K. KEILANY**, Ph.D. Indiana 1968. The role of national planning in economic development: Syria, a case study, 1960-1965.

The purpose of this study is to examine the role of economic planning in Syria and its contribution toward strengthening economic development efforts. More specifically, the study breaks down into five elements: (1) identification of the economic social background leading up to economic planning and the introduction of the First Five-Year Plan. This is done by examining the forces which led to record economic development and growth in the postwar period, and by identification of factors which contributed to the recent slowing down of the economic development. (2) Analysis and appraisal of the Plan and its strategy in terms of its internal consistency, intersectoral relations, allocations of resources, and the efficiency of bureaucracy. (3) Identifying actual progress toward achieving the goals of the Plan 1960-1964, and identifying the difficulties encountered in implementation. (4) Assessing the contribution of the planning process by asking: Have the planners or the process of planning significantly affected the overall emphasis or goals of government development policy? Have planners or the planning process affected the specific allocation of resources within the overall policy outline? (5) Summary and evaluation of the major findings.

**KIERAN A. KENNEDY**, Ph.D. Harvard 1968. Some aspects of the growth of labor productivity in Irish industry.

**NADIM G. KEHALAF**, Ph.D. Princeton 1967. Economic implications of the size of nations with special reference to Lebanon.

The study is an attempt to evaluate the implications of the size of nations (represented by population and GNP for a sample of eighty countries) on (1) economic stability, (2) concentration in trade, (3) dependence on trade, and (4) economic growth and development. Simple and multiple correlations, and a cross-classificatory scheme interpreted as crude partial correlations, are used to analyze the association between "size" and the mentioned four aspects. Lebanon is then chosen as an example of a small country in an attempt to assess the impact of the size of the Lebanese economy on each of these aspects.

**HANAA ABDEL-AZIZ KHEIR-EL-DINE**, Ph.D. Mass. Inst. Technology 1967.

A quadratic programming approach to the problem of optimal pricing and use of cotton in Egypt.

An interindustry programming model of the Egyptian economy is formulated with nine producing sectors involved in the growing and manufacturing of cotton—either as direct producers or as suppliers of intermediate inputs and capital goods to the cotton-producing sectors. The demand functions for cotton exports enter the model explicitly, allowing for the possibility that Egypt may influence the world market prices for long staples by restricting supplies. The model is a two-period quadratic programming model which solves for an optimal pattern of domestic production, exports and imports in the years 1970 and

1980. Through parametric variation of certain data, a series of optimal solutions for different restrictions is obtained, enabling comparisons to be made of the effect of various economic policies on the maximum benefit attainable.

MOHAMED W. KHOUJA, Ph.D. California (Berkeley) 1967. Economic growth and Syria's foreign trade sector: a theoretical and empirical study.

KWAN SUK KIM, Ph.D. Minnesota 1967. A model of growth and trade in a dual economy.

The Jorgensen, Ranis-Fei model of a labor-surplus economy is extended to treat two aspects of growth; one bearing on the open-economy implications and the other, on implications of sluggish factor adjustments. The model displays two equilibria; a stable and a saddle-point solution, depending on the relative sensitivity of migration and the population growth. The final part discusses the empirical relevance of the model to the Japanese experience.

YOUNG CHIN KIM, Ph.D. Columbia 1968. Under-utilization of manufacturing capacity in underdeveloped countries: its meaning, extent and possible implications.

WALTER J. KLAGES, Ph.D. Alabama 1967. The economic development of Russia: from thesis to anti-thesis—the roots and antecedents of modern Soviet strategy for economic growth.

DAVID C. KORTEN, Ph.D. Stanford 1968. Management, modern organization and planned change in a traditional society: a social systems analysis of cultural transition in Ethiopia.

RICHARD A. KRAUS, Ph.D. Harvard 1968. Cotton and cotton goods in China 1918-1936.

Entirely new and reasonably reliable indexes of cotton and cotton goods production and supply are developed for China. They are subdivided into traditional and modern sectors and chronicle the decline of handicrafts in China during the 'Twenties and 'Thirties. They also provide the first quantitative evidence that per capita income was declining in China throughout this period. And they imply that the cotton-related sectors of the traditional economy did in fact experience severe dislocation in the late nineteenth century.

V. N. KRISHNAN, Ph.D. Michigan State 1968. An analysis of wage trends in manufacturing industries in India: 1950-1960.

This study analyzes wage trends in manufacturing industries in India for the period 1950-1960. Indexes of money wages, real wages, fixed capital per worker, employment and consumer price indexes have been constructed for 26 manufacturing industries and 12 states. With the help of these the factors influencing the level of wages and those shaping their differentials have been analyzed with a view to focus on the issues raised by wage policy in economic development.

LEONARD KUBIN, Ph.D. California (Berkeley) 1967. Structural change in the United States economy: post-World War I versus post-World War II.

JOSEPH S. LACASCLA, Ph.D. Florida 1967. Capital formation in Mexico from 1958 to 1964.

JOSE M. LAWAS, Ph.D. Purdue 1968. Output growth, technological change and employment of resources in Philippine agriculture: 1948-75.

The objectives of the study were (1) to ascertain the sources of farm output growth during the period from 1948 to 1960, (2) to determine the total agricultural output that will be required by the economy in 1975 and (3) to estimate the combination of resources for alternative levels of technological progress to meet the projected agricultural output requirement.

SIMA LIEBERMAN, Ph.D. California (Berkeley) 1967. The industrialization of Norway; 1800-1920.

PETER D. MCCLELLAND, Ph.D. Harvard 1967. The New Brunswick economy in the nineteenth century.

A study of progressive regional retardation in a staples-oriented economy.

JOHN L. MADDEN, Ph.D. Kansas State 1968. Regional economic growth in historical perspective—Kansas 1860-1910.

This study examines the growth in income of Kansas between 1860-1910 within the context of changes in various factors (population, labor force, agriculture, industrial mix, education, political and social structure) which influenced the pattern of development.

MOSHE MANDELBAUM, Ph.D. Vanderbilt 1968. The role of development loans extended by the Israel government, in the process of industrialization, 1956-1962.

SUHADI MANGKUSUWONDO, Ph.D. California (Berkeley) 1967. Industrialization efforts in Indonesia: the role of agriculture and foreign trade in the development of the industrial sector.

JOHN A. MARLIN, Ph.D. George Washington 1968. Financial institutions and economic growth in South Africa, 1956-1966.

That the South African financial system represented a leading growth sector is shown by analysis of the sources and uses of funds of public and private financial institutions. Legislation introduced in 1964 to control near-banks was insufficiently flexible; crude controls were therefore imposed in 1965 on interest rates and bank credit, and this action hurt growth. Exchange and import controls were also used to direct financial flows.

FREDERICK O. MILLER, Ph.D. Michigan State 1967. The effect of highway improvements on agricultural production: an Argentine case study.

The effects of highway improvements on agricultural production were examined in the semi-arid area bordering National Highway 35, near Bahia Blanca, Argentina. The conclusions were based on background material from sources in Buenos Aires and Bahia Blanca and personally collected data from farms in the region. Substantial economic gains were not expected to arise from road improvements because of the physiographic limitations and institutional characteristics of the zone and the relatively slow adoption of modern farm techniques in the agricultural sector.

DANIEL J. B. MITCHELL, Ph.D. Mass. Inst. Technology 1968. Incomes policy costs, and the balance of payments: the cases of Britain and Australia.

British incomes policy since 1964 and the prospects for a wages policy in Australia are evaluated using a framework set forth in the first two chapters. Problems of labor mobility, export performance, industrial structure, and productivity guidelines are explored.

OSCAR E. MUÑOZ, Ph.D. Yale 1967. Long-run trends in the manufacturing industry in Chile since 1914.

SYED M. NASEEM, Ph.D. Yale 1968. Import substitution and industrialization: a programming model for Pakistan.

VAHID F. NOWSHIRVANI, Ph.D. Mass. Inst. Technology 1968. Agricultural supply in India: some theoretical and empirical studies.

This study deals with several aspects of agricultural supply in India emphasizing the estimation of supply response to prices for a number of crops in two northern states, Bihar and Uttar Pradesh. A model of rational price expectations is developed, which may be considered a modified form of the Nerlovian model and a method is suggested for distinguishing between the coefficients of expectation and adjustment. It is found that a significant positive response to price does not exist in a number of instances. A comparison of the results with those of previous studies of supply response shows that a statistically significant response to price depends on the extent of commercialization.

GUR OFER, Ph.D. Harvard 1968. The service sector in the Soviet Union.

The manuscript first establishes, by the method of multivariate analysis, that the share of the labor force employed in the service industries in the Soviet Union is considerably smaller than that in other market economies of similar "level of development." This discrepancy—concentrated mainly in trade, public administration, private and domestic services—is then analyzed and explained by: (a) "Socialist" growth strategy; (b) different organization of the economic system; (c) ideological convictions as to the unproductiveness of "service" workers; and (d) the abolition of private ownership of capital.

WALTER P. PAGE, Ph.D. Kansas 1968. A study of the linear homogeneous production function for agriculture in a selected region of the Great Plains, 1899-1903.

CARLOS M. PELAEZ, Ph.D. Columbia 1968. The State, the Great Depression and the industrialization of Brazil.

ALBERTO O. PETRECOLLA, Ph.D. Columbia 1968. Prices, import substitution, and investment in the Argentine textile industry, 1920-1939.

EFTHYMIOS POURNARAKIS, Ph.D. Kansas 1967. The open labor surplus economy: a formal model.

ROBERT C. REPETTO, Ph.D. Harvard 1968. Temporal elements of Indian development.

The dissertation explores the importance in the Indian economy of better management of time in project and program planning and execution, in the context of high implicit rates of time discount. Illustrative studies deal with the steel and fertilizer industries, irrigation, and family planning programs. Conclusions emphasize the potential for faster growth from available sources.

MICHAEL ROEMER, Ph.D. Mass. Inst. Technology 1968. The dynamic role of exports in economic development: the fishmeal industry in Peru 1956-66.

Staple theory emphasizes the importance of the export industry's production function in stimulating growth. A considerable literature of skepticism towards export-led growth strategies for developing countries has arisen since the second world war. However, these arguments overstate the case against export-led growth in developing countries. The recent history of Peruvian fishmeal demonstrates that raw-material exports are still capable of stimulating rapid and sustained economic growth.

JOHN B. ROSS, Ph.D. Duke 1967. The economic system of Mexico.

DONALD F. SCHAEFER, Ph.D. North Carolina 1968. The growth of the Pennsylvania anthracite coal industry 1820-1865.

DEAN F. SCHREINER, Ph.D. Iowa (Ames) 1967. An integrated growth model for the basic sectors and dependent residuary sectors of Southern Peru.

HUGH H. SCHWARTZ, Ph.D. Yale 1967. The Argentine experience with industrial credit and protection incentives, 1943-58.

DOUGLAS A. SCOTT, Ph.D. Harvard 1968. Growth and crisis, economic policy in Ghana, 1946-1965.

SARASWATI P. SINGH, Ph.D. Kansas State 1968. Analysis of the causal factors in the development of a milk marketing institution in India.

A study of the factors, especially the human leadership that contributed to the successful development of a cooperative milk marketing and processing organization serving 100,000 farmer members in Gujarat State.

COURTENAY SLATER, Ph.D. American 1968. External debt and economic development: some empirical tests of macroeconomic approaches.

A long-term macroeconomic model designed to illustrate the patterns which the external capital flows and external debt of a country might follow if the country borrows development funds abroad over an extended period is described. The model is a modified version of the savings constraint model developed by Dragoslav Avramovic, the most important modification being the introduction of a foreign exchange constraint. The model is tested empirically through a cross section survey of a number of less developed countries and a detailed examination of Chile and is shown to have considerable relevance to Chilean experience from 1957 through 1965.

BARBARA L. SOLOW, Ph.D. Harvard 1968. The Irish land question after 1870.

JOSEPH J. STERN, Ph.D. Harvard 1968. Growth, development and regional equity in Pakistan.

The purpose of this study was to analyze the effects of a regional growth objective on the allocation of resources in a national economy and on the rate of growth of the national income. Consideration was given to a number of alternative policies ranging from a policy aimed at maximizing only national income with no consideration for regional income parity to a policy whose objective would be to equate regional per capita incomes by 1985. The analysis was carried out first by use of an aggregate inter-temporal programming model and then, using the results of these aggregate solutions, on a static sectoral model.

THOMAS W. SYNNOTT, III, Ph.D. Yale 1968. Investment policies, growth and profitability in the New England cotton textile industry 1830-1914.

LANCE J. TAYLOR, Ph.D. Harvard 1968. Aggregate structural change: recent time-series and cross-section evidence.

The thesis describes investigations of changes in value-added shares of industry, primary production, and services during recent years in 54 countries. An interindustry simulation model is developed, and used together with cross-section (CS) regressions for final demand components to generate predicted shares as functions of per capita income and population. The predictions are shown to resemble CS regressions, particularly in curvature properties and the significance of different forms of the equations for "large" and "small" countries. In addition, it is shown that time-series (TS) share changes are consistent with the CS regressions, although there is considerable dispersion of TS elasticities about their CS counterparts.

SURESH D. TENDULKAR, Ph.D. Harvard 1968. Some experiments in a multi-sectoral programming model for India.

MICHAEL P. TODARO, Ph.D. Yale 1967. The urban employment problem in less developed countries: an analysis of demand and supply.

ABDUL R. S. TOUKAN, Ph.D. Vanderbilt 1967. The implications of achieving fiscal independence for Jordan.

PHAM VAN THUYET, Ph.D. Pennsylvania 1967. Government finance and economic development in Viet-Nam with special reference to the impacts of U.S. aid.

LEE VAN ZANT, Ph.D. Texas 1967. State promotion of railroad construction in Texas, 1836-1900.

ROBERT P. VICHAS, Ph.D. Florida 1967. External financing of the Nicaraguan development experiment.

Over a ten-year interval, 1955-1964, the dissertation analyzes the influence of public and private foreign capital on economic growth in Nicaragua. The poorly defined policy has been one to promote import substitution. The role of external resources has been pivotal in establishing net gains in income for the period in spite of a proliferative population. Salient structural permutation essential to self-sustaining growth appears not to have transpired during the examined period.

WILLIAM G. WHITNEY, Ph.D. Harvard 1968. The structure of the American economy in the late nineteenth century.

The author analyzes structural change in the American economy over the final two decades of the nineteenth century by constructing a twenty-nine sector input-output table for 1899. The rapid industrialization of the period is traced primarily to demand forces, with import substitution and lagging demand for agricultural goods the decisive factors. Aggregate production functions for each of the manufacturing sectors reveal that technological change was not a significant element stimulating economic growth.

CALMAN R. WINEGARDEN, Ph.D. Case Western Reserve 1967. The balanced-growth controversy: a review and reformulation.

An analytical review of the balanced-growth and unbalanced-growth strategies for development. The differences among the variations of balanced strategy and of unbalanced strategy are examined, and the common outstanding characteristics of the two strategies are compared. The choice of strategy is dependent upon the conditions in specific developing economies, such as size, natural resources, capital availability, opportunity for foreign trade, entrepreneurship, and the stage of development.

JAN P. WOGART, Ph.D. Texas 1968. Demand-pull, corrective, and cost-push inflation in Latin America: the case of Brazil, 1964-1966.

Analysis and critique of the Brazilian Action Program (1964-1966/67). Empirical research on fiscal and monetary policies supports the following two hypotheses: first, contrary to assertions of many economic observers, the stabilization attempt of the Castello Branco government represented a well-conceived synthesis of "monetarist" and "structuralist" elements, with emphasis on the latter. Secondly, the failure to decelerate inflation substantially until 1966 can be explained by the continuation of inflationary price expectations rather than by the emergence of cost-push elements.



UWE J. WOLTEMADE, Ph.D. Texas 1967. The emergence of a market economy and socio-economic change in rural India.

The thesis investigates the transformation in village India from a nonmarket to a market economy and society. It examines this process in a tripartite fashion, i.e., an exposition and analysis of: (1) the economy and social structure of the traditional, pre-British village, (2) the forces of economic impact (communications, commerce, western landownership concepts, and agricultural improvements), and (3) the response of the old multi-purpose institutions to that impact. The source material for this account consists largely of ethnographic studies of rural communities in various parts of the Indian sub-continent.

BETTY S. YASER, Ph.D. Vanderbilt 1967. The effects of financial variables on economic growth in Turkey 1949-1963.

PAUL ZAREMBKA, Ph.D. Wisconsin 1968. A long-run economic growth for the underdeveloped countries.

A neoclassical model for underdeveloped economies is constructed around production functions for the primary, secondary, and tertiary sectors. Utilization of inputs except agricultural labor is determined by profit maximization. Equations for urban versus rural wages, the domestic price level, exports, imports, and the foreign exchange rate are also specified. The closed 28 equation model is estimated for Colombia and Japan in part by three-stage least squares with linear restrictions on coefficients and is also simulated.

### Statistical Methods; Econometrics; Social Accounting

VIRAPONG BOONKITTICHAROEN, Ph.D. Indiana 1968. A proposed alternative formula for approximating cost of living index numbers.

This study is concerned with the problem of computing a cost-of-living index number. Both statistical and economic theories of cost of living index numbers are investigated. As a result a new formula for computing such index numbers is proposed.

STEPHEN K. CAMPBELL, Ph.D. Columbia 1968. Measuring the effects of selected smoothing formulas upon economic time series: an experimental study.

Thirty-four moving average formulas are applied to six time series having MCD values ranging between 1 and infinity and are evaluated statistically in terms of (1) smoothing power, (2) phase-correspondence propensity, (3) amplitude-correspondence propensity, and (4) goodness of fit. The results are analyzed with a view to developing new formulas having especially high orders of smoothing power and techniques for predicting which of several alternative formulas are likely to smooth a particular time series most effectively.

DAVID N. G. CARTER, Ph.D. Mass. Inst. Technology 1967. On the use of a nonlinear criterion function in development programming models.

In this study, concerned with multisector optimizing models, a nonlinear criterion function, specifically the weighted log linear function is specified instead of a linear function. This criterion function is then applied to the Sandee model and the Eckaus Transit model. It is shown that there is a bias towards the industrial capital intensive sectors at the expense of agriculture as a result of a linear specification of the criterion function.

HARRELL C. DAVIS, Ph.D. California (Berkeley) 1967. Multiregional input-output model of the Western States emphasizing heavy-water using sectors.

PERIYAPATNA S. DERUVARAJAN, Ph.D. Northwestern 1967. Maximum likelihood estimation of simultaneous equation systems with temporally dependent disturbances.

JOHN B. EDWARDS, Ph.D. Harvard 1968. An investigation of research strategies for specifying an econometric model.

HERMAN L. GILSTER, Ph.D. Harvard 1968. A statistical analysis of maintenance costs on large jet aircraft.

Topics covered include the effects of ineffective maintenance, skill levels, manhour availability, climate, aircraft age, and protracted ground stands on failure patterns and manhour behavior. Maintenance cost models are discussed and cost estimates for common aircraft systems are presented. The data base covered 35,000 flights on the Boeing B-52.

RICHARD W. GOBER, Ph.D. Alabama 1967. Discernible periods in the historical development of statistical inference.

ROBERT GORDON, Ph.D. Mass. Inst. Technology 1967. Problems in the measurement of real investment in the U.S. private economy.

Chapter summaries: Chapter 1: introduction; (2) estimates of investment expenditures; (3) government financed assets in private operation; (4) the deflation of investment expenditures; and (5) conclusion.

MERLIN M. HACKBART, Ph.D. Kansas State 1968. Input-output analysis: an evaluation of its application to regional input-output impact studies using secondary data.

The applicability of input-output models derived entirely from secondary data for use in resource development evaluation analysis is the prime goal of the thesis. Partial inter-industry flow models are developed to facilitate the evaluation of employing secondary data to implement various segments of an interindustry study. The general conclusion of the investigation was that modified input-output matrices are difficult to implement from secondary data unless locally available data can be used to supplement national and state data. This implies that it is difficult to develop comparable matrices from region to region.

CHENG-JU HUANG, Ph.D. North Carolina 1968. The predictive testing of economic theories and the simultaneous equations model.

The merits of using the asymptotic distributions in econometric theories and predictive testing of a simultaneous equations model are examined. It is argued that in current econometric practices the number of observations are not usually large enough to apply the asymptotic distribution. Based upon this conclusion, the predictive testing of economic theories is suggested. L. R. Klein's Model I of the United States, 1921-1941, is demonstrated as an example.

PETER KENNEDY, Ph.D. Wisconsin 1968. An existence analysis of recursive programming models.

An existence proof for general recursive programming systems is presented. Several standard economic models (a Cournot model, a general equilibrium model, and a growth model) are formulated in a recursive programming framework and analyzed in the existence context. The development and analysis of these models should aid researchers wishing to formulate more realistic recursive programming models, and should also promote a better understanding of economic literature containing existence analyses, notation, or concepts. WILLIAM E. MCFARLAND, Ph.D. Michigan 1968. A technique for the sensitivity analysis of macro-economic models.

BARBARA MURRAY, Ph.D. Wayne State 1967. Interpersonal income inequality and interareal variation in income levels of the fifteen largest SMSA'S.

THOMAS PALM, Ph.D. Michigan 1967. The possibility function: on the outlook for national social accounting in the context of the history of economic thought.

JAMES RAMSEY, Ph.D. Wisconsin 1968. Tests for specification errors in classical linear least squares regression analysis.

The basic model considered is the linear regression model with K-1 regressors. Five misspecifications of the model are discussed: omitted variables, errors in the variables, incorrect functional form, simultaneous equation problems, and heteroskedasticity. First, the effects of the specification errors on inference and on the distribution of the least squares residuals are examined. Based on the analysis in this section four tests of specification error are developed.

ROBERT J. ROHR, Ph.D. Purdue 1967. An investigation of the stability properties and the sampling distributions of estimators and test statistics associated with a dynamic simultaneous equations model.

BARR ROSENBERG, Ph.D. Harvard 1968. Varying-parameter regression.

When the parameters as a regression are represented (perhaps through some linear transformation) as a Markov process evolving over time, constant-parameter regression methods may be generalized to yield optimal estimates of the values assumed by parameters in all periods and the variance-covariance matrix of all estimation errors. Calculations are remarkably simple. The resulting methods are very well suited to adaptive forecasting, and

provide both an opportunity and a demand for research into the variation of behavioral parameters in econometric models.

RONALD A. RUBEL, D.B.A. Harvard 1967. Decision analysis and medical diagnosis and treatment.

ROSE M. RUBIN, Ph.D. Kansas State 1968. Aggregation criteria in input-output analysis.

Aggregation in input-output analysis is conceived with reducing the size or complexity of a matrix. Theoretical aggregation criteria and three specific empirical criteria, by which the relative goodness of the aggregation achieved can be measured, are discussed. The minimum distance criterion, developed by Walter D. Fisher, is emphasized and tested in detail. The results indicate that the relative size of the original sectors is the most important determinant of the aggregation partition obtained.

AHMAD H. SEAMSEDDINE, Ph.D. George Washington 1968. Expansion of imputation in national income and product accounts: a case study of the value of housewives' services in the United States.

The study investigates the conceptual, statistical, and practical grounds of the current imputations in the national income accounts. After suggesting some possible corrections and improvements in their estimates, the study makes a case for expanding the list of imputations, a method of estimating the value of the housewives' services in the United States for the years 1950 through 1964. The conclusion is that there are clear interrelationships, direct and indirect, between the contributions of housewives to GNP and business cycles, the employment rate of married women, the stock of household appliances and equipment, technological progress, and other factors.

ABRAHAM SUBOTNIK, Ph.D. Cornell 1967. The development of an econometric model for policy decision-making in Israel.

ROBERTUS B. SUHARTONO, Ph.D. Wayne State 1968. The Indonesian economy: an attempt in econometric model analysis.

E. HERBERT TINNEY, Ph.D. Wisconsin 1968. Analysis and simulation of dynamic micro-economic models.

### **Economic Systems; Planning and Reform; Cooperation**

NANCY S. BARRETT, Ph.D. Harvard 1968. Planning for regional economic development: a proposal for France.

This study investigates the problems associated with the concentration of French industry in Paris. A proposed program for industrial decentralization is based on the concept of a polarized region and incorporates the economic base-regional multiplier approach into a set of regional constraints which could be introduced into a national planning model of the French type.

ANTONIO S. DE VALE E VASCONCELLOS, Ph.D. Tulane 1968. Toward the systemization of economic policy: the French experience in economic planning.

The need for some technique of systematizing economic policy is becoming increasingly felt with its growing complexity. One such technique is economic planning. In the West, France provides, perhaps, the most interesting case of planning in a market economy. Accordingly, the central object of the study is to examine the French approach to planning and analyze and compare the performance of the French economy under planning. Attention is also given to the tools and macroeconomics of planning and to the inadequacies in the preparation and implementation of the French Plan.

MARVIN R. JACKSON, Ph.D. California (Berkeley) 1967. Soviet project and design organizations: a study of technological decision-making in a command economy.

MICHAEL KEREN, Ph.D. Yale 1968. Central allocation of resources under uncertainty.

JOHN E. KOEHLER, Ph.D. Yale 1968. Information and policy-making: Mexico.

WILLIAM C. MORSCH, Ph.D. Harvard 1968. The economic planning system in economic development.

ABDEL M. A. RADY, Ph.D. Syracuse 1967. The role of cooperative organizations in economic planning.

BILL F. ROBERTS, Ph.D. Minnesota 1967. An application of dynamic programming to regional economic planning.

Regional planning is approached in the context of national planning. A dynamic national model, disaggregated by region and by sector, is constructed to determine optimal paths of national and regional production and investment, and the optimal transfer of goods, over a finite time horizon. The model accommodates the specification of depreciation, immobility and nonmalleability of productive factors. An iterative computational procedure is developed from the dynamic programming recurrence relation.

### Business Fluctuations

S. PETER BURLEY, Ph.D. Princeton 1968. Fluctuations in the Australian economy viewed by frequency techniques.

Frequency methods of statistical analysis are applied to the analysis of business cycle fluctuations in Australia. It is found that the techniques of spectral analysis provide a concise description of most cyclical phenomena. Further, a related technique of data analysis is suggested: a consideration of the sequence of relative phases of the demodulates of different economic time series. This provides useful information concerning the stability and structure of the hypothetical lagged relationships proposed by theoretical economic dynamics.

CEOMPLOEN CHANDR-RUANG-PHEN, Ph.D. North Carolina 1967. A study of industrial price behavior in business cycles.

NANCY S. DORFMAN, Ph.D. California (Berkeley) 1967. The role of money in the investment boom of the twenties and the 1929 turning point.

C. RICHARD LONG, Ph.D. Vanderbilt 1968. An evaluation of Ashley Wright's forecasting method.

### Money, Credit and Banking; Monetary Policy; Consumer Finance; Mortgage Credit

JOHN ANDERSON, Ph.D. Pennsylvania 1967. Effect of the balance of payments upon American monetary policy.

A study of the influence which external economic factors as transmitted through our balance of payments have had upon the process of formulating and executing American monetary policy from 1879 to 1965. Indicates how the American authorities became disillusioned with the rules of the classical gold standard and so developed discretionary policies which were often selective in nature.

PETER R. ANDERSEN, Ph.D. Harvard 1968. Discretionary and contractual saving in Canada, a cross-sectional study.

This study examines the influence of specific contractual saving flows upon discretionary saving, and the determinants of such contractual saving. Statistical results indicate a positive pension contribution effect and negative life insurance premium and mortgage repayment effects on discretionary saving. The pension effect is strongest for the sample sub-group which excludes high income households. Region and immigrant status, along with life cycle and permanent income measures, are important predictors for life insurance premiums and mortgage repayments.

RICHARD C. ASPINWALL, Ph.D. Columbia 1968. A study of factors affecting commercial bank performance in the market for conventional residential real estate loans.

This study examines the relationship of the structure of mortgage credit markets to interest rates charged by commercial banks for conventional loans on single family dwellings. Market structure is measured by a concentration ratio and the number of lenders, and these variables include not only commercial banks, but also mutual savings banks and

savings and loan associations. Regression analysis of data for 43 metropolitan areas reveals that, holding constant geographic location and loan terms (dwelling price, down payment, and loan maturity), there is a significant association (at the five per cent level) between contractual rates of interest and both concentration and number of lending institutions.

JOSEPH H. AUGUSTA, Ph.D. Maryland 1968. The role of time deposits in bank asset selection.

This study investigated the influence of the proportion of time deposits in bank asset selection. The hypothesis tested was that a larger proportion of time deposits, by increasing deposit stability, lead to banks selecting less liquid assets. The empirical results supported this hypothesis by showing that a higher proportion of time deposits is associated with a higher loan/deposit ratio, a lower excess reserve/deposit ratio, and increased maturity of the securities portfolio.

CHRISTOPHER L. BACH, Ph.D. Case Western Reserve 1967. Federal Reserve policy, 1955-1958.

An evaluation of monetary policy in 1955-58 and of contemporary criticisms of the Federal Reserve in light of contemporary and subsequent knowledge. Reserve policy was successful in breaking the pattern of long-run inflationary expectations and laid a base for a period of price-level stability.

BIXIO BARENCO, Ph.D. California (Berkeley) 1967. The relationship between assets, investment, and finance in an open and in a closed economy.

MILTON F. BAUER, Ph.D. Chicago 1967. The Caisse Populaire Movement in Quebec, 1932-1950.

This dissertation attempts to determine the major factors responsible for the growth and development of the Movement from 1932 to 1950, and to estimate the Movement's impact on the Quebec economy.

FRANK J. BONELLO, Ph.D. Michigan State 1968. The term structure of interest rates, the expectations hypothesis, and the formulation of expected interest rates.

In several empirical investigations into the expectations hypothesis independent specification of expected interest rates is required. Although the methods of achieving this specification are quite varied, all the studies provide impressive results. This study focuses attention directly on these different methods and attempts an empirical evaluation of the methods themselves.

ROBERT H. CHANDROSS, Ph.D. Princeton 1968. The impact of new bank entry on the existing banks in the market.

This study analyzes the impact of new bank entry on the existing unit banks in one- and two-bank towns. During the three-year pre-entry period these banks had above average rates of return on capital and assets and below average ratios of loans to assets. Following the entry of a new bank the rates of return declined and the output of loans rose to levels about equal to those for all banks in their respective states.

JACK L. COOPER, Ph.D. North Carolina 1968. Member bank borrowing from the Federal Reserve Bank of Chicago, 1951-1966.

The purpose of this dissertation was to provide a detailed examination of the borrowing patterns of member banks in the Seventh Federal Reserve District. The first part of the essay, a historical review of borrowing patterns during the post-accord period, emphasizes aggregate measures of borrowing activity for reserve classes over time. The second part of the essay, a cross-section analysis, focuses on systematic differences in borrowing intensity and duration of indebtedness among individual banks during 1966.

THOMAS J. COYNE, Ph.D. Case Western Reserve 1967. The banking structure in West Virginia.

The completely unit banking structure of West Virginia is examined for the period 1949-1965 as to level of banking concentration and profitability. Population per bank is above national average, yet total asset growth is hindered by economic conditions in the state. Larger banks appear to obtain concentration of power, and above-average profits. Greater freedom of entry and limited branch facilities would provide greater public service and alleviate asset concentration.

WILLIAM W. CURTIS, Ph.D. Illinois 1967. An investigation of consumer debt portfolios.

A study based on data collected by Consumers Savings Project at the University of Illinois. Included are: (1) descriptive characteristics of families in debt, (2) tests of significant differences between debtors and nondebtors, and (3) a discussion of the sources and uses of borrowed funds. The emphasis is on debt ownership versus nonownership, with some attempt to predict amount of debt by type.

GEORGE G. DALY, Ph.D. Northwestern 1967. Financial intermediation and the theory of the firm: an analysis of Savings and Loan Association behavior.

VERNON L. DESLATTES, Ph.D. Louisiana 1968. The demand for savings bonds in the United States—with emphasis on the significance of interest rates in the postwar period.

ARNOLD A. DILL, Ph.D. Washington (St. Louis) 1967). Causes and effects of commercial bank innovation.

This thesis explores episodes of commercial bank innovation in the 1920's and post War II period. It is concluded that the Federal Funds markets and time deposit expansions of these periods were reserve-conserving innovations in response to profit opportunities. A static model of the bank firm is used to prove that institutional constraints characteristic of the banking industry can increase the price of reserves to the bank and raise returns to reserve-conserving innovations.

JAMES F. DINGLE, Ph.D. Mass. Inst. Technology 1968. The effects of monetary policy on the purchases of consumer durable goods in Canada.

It is hypothesized that the cost of consumer installment credit forms a significant link between monetary policy and the purchases of consumer goods in Canada. Monetary policy is measured by operations on the Treasury bill rate. Substitution between bills and commercial paper renders the short-term paper rate sensitive to the policy variable. A portion of this variation is passed along to consumers in revised finance charges. A reduction in expenditures on durable goods results from higher charges. A quarterly econometric model is employed to quantify each of these relationships.

JOHN A. DOMINICK, Ph.D. Alabama 1967. The role of silver money in the monetary history of the United States.

WILLIAM J. FRAZER, JR., Ph.D. Columbia 1968. The liquidity structure of firms and monetary economics.

This essay deals with the effects of asset size on the liquidity structure of firms and with both new and old topics in monetary economics. It derives a part of its uniqueness from the emphasis on the effect of bank loans on the demand for money, and from its particular emphasis on the complications imposed by structural differences on the interpretation of movements in selected time series.

BARRY L. FRIEDMAN, Ph.D. Mass. Inst. Technology 1967. The demand for money: testing a Neo-Fisherian hypothesis.

A model is constructed which involves two gradual adjustment processes. One is a learning process by which desired velocity responds slowly to changes in interest rates. The other is a process in which individuals attempt to adjust their actual stock of cash balances slowly to a target defined by the learning process. This model is compared with the permanent income model. It is found that when both models are corrected for autocorrelation the Neo-Fisherian approach clearly out-performs the permanent income approach.

ROBERT L. FRNKA, Ph.D. Southern Methodist 1967. The demand for money and its substitutes.

The study is concerned with the substitutability between money (demand deposits and currency) and other liquid assets (time deposits, saving shares, etc.). The evidence from time series indicates that money is a fairly good substitute for some type of liquid assets and therefore it is concluded that the use of general credit controls by the Federal Reserve may have unintended impacts on some sectors of the economy.

DONALD M. T. GIBSON, D.B.A. Harvard 1968. A study of the strategic and operational significance of the credit card for commercial banks.

WILLIAM E. GIBSON, Ph.D. Chicago 1967. Effects of money on interest rates.

This study examined the operation of three effects of changes in the money stock on interest rates: liquidity, income, and price-expectations effects. For U.S. data, an increase

in the money stock brings about an immediate fall in market interest rates, but only a few months later it causes rates to rise to their previous levels, due to increases in income. Price-expectations effects on interest rates were also measured, and a positive relation was found between interest rates and expected rates of price change when the latter were approximated by past rates of price change.

JOSEPH J. HOARON, JR., Ph.D. Southern Methodist 1968. The theory of the determination of the money supply: an expansion of the Friedman-Schwartz equation and an alternative model.

It is shown that neither the Friedman-Schwartz equation nor a supply function built up from a multiple equation financial model is free from demand elements. If demand and supply analysis is to be used, a multiple equation financial market approach which does not use the concept of money should be employed. A single equilibrium statement is preferable in cases in which the concept "money" is too useful to be discarded.

DWIGHT M. JAFFEE, Ph.D. Mass. Inst. Technology 1968. Credit rationing and the commercial loan market.

A structural model of the commercial loan market, fully integrating the possibility of nonprice credit rationing, is formulated and tested. The model consists of two equations on the supply side, explaining the degree of credit rationing and the loan rate, and one equation on the demand side explaining the quantity of loans outstanding. Credit rationing is shown to be a mode of rational behavior and an empirical proxy measure for rationing is developed.

JAMES L. KICHLINE, Ph.D. Maryland 1968. Substitutability of claims at depository institutions.

This dissertation investigates the degree of substitution among consumer-type claims at the three largest depository institutions—commercial banks, savings and loan associations, and mutual savings banks. Demand functions were estimated for five types of claims utilizing multi-cross-section data for a sample of Standard Metropolitan Statistical Areas. Income-yielding claims, in general, evidenced a significant degree of substitutability for each other, whereas demand deposits exhibited a limited degree of interest rate sensitivity. Convenience factors were found to be important arguments in the estimated demand functions.

ROBERT E. KNIGHT, Ph.D. Harvard 1968. Federal Reserve System policies and their effects on the banking system.

Since postwar Federal Reserve open market policies have generally aimed at maintaining free reserves within a target range, the primary focus of this study is the determination of free reserves and the effects that variations in free reserves have on bank credit expansion. A model of Federal Reserve behavior, making free reserves a function of several business cycle indicators, is developed. The growth in member bank loans and investments is proportional to the difference between the actual level of free reserves and the level desired by the banking system. During normal circumstances the primary determinant of bank demand for free reserves is the demand for loans. The excess demand model for free reserves explains changes in loans and investments more satisfactorily than the extended monetary base, nonborrowed reserves or the sum of currency in circulation and nonborrowed reserves.

NICOS A. KOUBIS, Ph.D. Yale 1968. Factors affecting the demand for money in Greece: an econometric study.

HAYNE E. LELAND, Ph.D. Harvard 1968. Dynamic portfolio theory.

Portfolio theory is extended to an  $N$  period model, using dynamic programming to maximize expected utility. The problem is analyzed with and without intermediate consumption and income. Necessary and sufficient conditions for separation and for myopic policies to be optimal are derived; they are closely related. Consumption is linear in permanent income for utility functions satisfying separation criteria; a subject implies proportionality. "Turnpike" consumption and portfolio strategies are derived; tax and liquidity preference effects are analyzed.

ROLF J. LUDERS, Ph.D. Chicago 1968. A monetary history of Chile: 1925-1958.

The study shows the close relationship between the behaviour of price movements and

the money supply. It explains changes in the money supply by analyzing (a) movements in the deposit-reserve and the deposit-currency ratios, and (b) changes in the supply of high-powered money. These are then explained in terms of Central Bank (1) foreign exchange operations and (2) credits to the public and private sector. Social, political and economic forces responsible for these Central Bank operations and credits are analyzed. THAMFY MAMMEN, Ph.D. Pennsylvania 1967. An econometric study of the money market in India.

WILLIAM McCLEARY, Ph.D. California (Berkeley) 1967. Monetary policy, debt management, and the term structure of interest rates.

PETER L. MILES, Ph.D. McGill 1968. Assets and liabilities of chartered banks: an econometric analysis.

In this thesis empirical knowledge of bank portfolio behavior in Canada, using econometric techniques, is extended in two major respects. First, the argument is, that the nature of the legal reserve restraints in Canada (in the period 1954-1965) is such that the demand equation for excess reserves is not identifiable in a model which aggregates over all banks. Therefore, bank earning asset accumulation must be examined directly by estimating equations which explain the demand by banks for the components of their earning asset portfolio. Second, there is an investigation of the influence of interest rate expectations on the portfolio behavior of banks and the nonbank public (insofar as the public's behavior is reflected in its demand for bank liabilities). There is further analysis of the effects of risk on these markets, since the theory of portfolio selection holds that the risk associated with a given expected return is an important variable in investors' utility functions.

SANDRA O. MOOSE, Ph.D. Harvard 1968. An analysis of fluctuation in commercial bank demand deposits: 1955-1965.

This thesis attempts to explain fluctuations in demand deposits from 1955 to 1965. It does so by estimating separate demand functions for corporations and individuals. Cross-section and time-series estimates are obtained by using data in a differenced form. The variables employed are largely those suggested by the portfolio theory or corporate cash management studies. The results seem to confirm that corporate and personal demands are influenced by quite distinct factors and have separate patterns of stability.

NEIL B. MURPHY, Ph.D. Illinois 1968. A study of wholesale banking behavior.

The purpose of this study is to examine the production and sale of wholesale banking services. A set of production constraints on bank output is constructed. Standard cost and production theory is employed to analyze the constraints on real output while the level of capital is specified as the constraint on financial output. These functions are disaggregated to construct a tied-sale theory of price behavior. Finally, the policy implications of the model are discussed.

KEIZO NAGATANI, Ph.D. Brown 1968. Money in a growing economy.

This is a theoretical study of the role of money in the growth process of a closed, neo-classical economy. First, the study presents a unified account of the role of money in capacity growth. Second, it extends capacity growth models to accommodate unemployment. The importance of the relationship between money wage flexibility and price flexibility is discussed. Third, of a set of different monetary stabilization policies, a unique best policy is identified.

JOHN A. NAYLOR, Ph.D. Illinois 1968. Some empirical and theoretical considerations relative to the term structure of interest rates.

The determination of the empirical relevance of the two major theories of the term structure of interest rates was the purpose of this thesis. It was found that when the implications of the major theories are tested using both investors' portfolio and interest rate data (for U.S. government securities), the results tend to be consistent with the market segmentation theory and inconsistent with the expectations theory.

CHARLES F. PEAKE, Ph.D. Maryland 1968. The monetary analysis of Henry Thornton and its significance in the development of British monetary economics.

Henry Thornton was the leading monetary economist of the Bullion Era although this role is sometimes attributed to Ricardo. The non-neutral-money model developed in Thorn-



ton's *Paper Credit of Great Britain* (1802) anticipated some Keynesian concepts and the Sayers-Radcliffe emphasis on the overall credit structure. Although his contributions have not been widely recognized in the literature, Thornton exerted a traceable influence on British monetary thought. Based on ideas similar to Thornton's, British policy makers rejected neutral money in the 1870's.

IRVING PLOTKIN, Ph.D. Mass. Inst. Technology 1968. The determinants of commercial bank operating costs: an econometric analysis of activities and services.

Previously employed data and statistical techniques cannot reveal the true cost functions nor the extent of economies of scale in commercial banking. By applying new econometric procedures to a novel data base this study sought to isolate and measure individual cost-incurring activities and services. Redefining the cost measure to include labor-replacing (automation) expenses as well as actual labor expenses, changed the cost function from one of apparently unlimited economies of scale to one which exhibits early exhaustion of overall economies as asset size increases. Applications for bank management and regulation are illustrated.

WILLIAM S. RAWSON, Ph.D. Duke 1967. Entry, exit, and the structural evolution of markets. A case study of Georgia banking, 1900 to 1964.

PAUL E. ROBERTS, JR., Ph.D. Iowa 1968. An examination of the lending policy of leading international financial institutions in the light of a comparative analysis of private and public development banks.

ROY J. RUFFIN, Ph.D. Northwestern 1967. The regional impact of open market operations: an econometric study.

RAIS B. SANTMAN, Ph.D. George Washington 1968. Determinants and behavior of the money supply in Malaysia.

The balance of payments has been the principal determinant of the money supply in Malaysia. The currency component varies in automatic response to variations in the balance of payments position. The evidence on the link between the deposit component of the money supply with the balance of payments is inconclusive. The evidence refutes the widely held assumption of the existence of large swings in the money supply on the basis of the volatility of Malaysian exports.

THOMAS J. SARGENT, Ph.D. Harvard 1968. The structure of interest rates.

DONALD SAVAGE, Ph.D. Wisconsin 1967. The unit bank in a branch banking state: a case study of Maine.

The dissertation examines the effects of permissive branch banking legislation on the unit banks in the State of Maine over the period 1926 to 1962. While the introduction of branch banking caused a great reduction in the number of unit banks, those unit banks that remained in 1962 had adopted the balance sheet characteristics, such as loan ratios, of the branch banks but earned significantly lower profits than the branch banks.

BAUDOUIN R. SCHEYVEN, Ph.D. Columbia 1968. Some aspects of the European Giro experience.

JOHN M. SINCLAIR, D.B.A. Harvard 1967. An evaluation of the determinants of success in the installation of computers in commercial banks.

JAMES J. SULLIVAN, Ph.D. Johns Hopkins 1968. Alternative models of Federal Reserve behavior.

In this study, alternative linear decision rules for the Federal Reserve were derived, and estimates of the parameters of the rules were obtained in the period 1952-65. The rules reflect differing assumptions about the lag structure and the relevant financial variables. The results suggest that open market operations were performed primarily to stabilize financial markets and, in particular, in the 1959-65 subperiod in response to the balance of payments problem.

J. ERNEST TANNER, Ph.D. Brown 1968. The timing of the effects of monetary policy.

This study was designed to determine the required money supply changes to offset exogenous changes in aggregate demand. The theoretical portion develops and solves a dynamic national income model, characterized by distributed lags in each of the structural equations. The empirical section attempts to estimate the model and the empirical co-

efficients indicate that the short-run effects of a change in the money supply are about equal in magnitude to the long-run effects.

HOWARD A. THOMPSON, Ph.D. Alabama 1968. The effective cost of urban home mortgage borrowing as it relates to specific borrower characteristics associated with the underincomed, undereducated and underfranchised in Tuscaloosa, Alabama.

Income, formal education, experiential education (mortgages negotiated previously, lenders shopped, and financial information source utilized), and enfranchisement (race and job status) were regressed, using nonparametric techniques, with a specially derived cost of financing common denominator—cost per \$100 per year financed. The study found no “exploitation” of underincomed, undereducated or underfranchised residential mortgage borrowers. Instead, higher financing costs correlated with borrowers best able to afford them—the more affluent and better endowed utilizing conventional loans.

RICHARD D. TOWEY, Ph.D. California (Berkeley) 1967. Commercial bank time deposits and some of their implications for Federal Reserve policy.

WILLIAM S. TOWNSEND, Ph.D. Texas 1967. Competition for deposits between bank and nonbank financial intermediaries.

This study seeks to ascertain the extent of competition for deposits between commercial banks, savings and loan associations, and mutual savings banks. Statistical demand functions were estimated in both linear and log-linear form for the deposit liabilities of these intermediaries; cross-section, temporal cross-section, and time series data, for the 1951-64 period, were used. The estimated parameters in our demand functions suggest the existence of competition for deposits between the principal depository-type financial intermediaries.

THOMAS VELK, Ph.D. Wisconsin 1967. Positive policy design and the Chicago monetary reforms.

The thesis applies some of the results of a combination of the “Amsterdam” theory of control and the cybernetic view of communication-command to the literature surrounding the Chicago-normativism controversy. The Chicago rules for monetary reform are shown to have many properties which are formally identical to those possessed by goals or targets: it is in this sense that we conclude that the Chicago monetary reforms are normative.

WALLACE H. WILSON, Ph.D. Michigan 1968. The determinants of short-run change in consumer time and savings balances.

EDGAR W. WOOD, Ph.D. Louisiana State 1967. Credit union development in Louisiana.

Credit unions are cooperative financial institutions narrowly restricted by their legal framework to accumulating the savings of and extending loans to persons in a limited field of membership. This dissertation traces the development of these institutions in the United States and Louisiana and assesses their economic role and impact and suggests some improvements which should be made in their legal framework as a result of certain unique solvency, liquidity and equity problems which they possess.

HENRY W. WOUDEBERG, Ph.D. Michigan State 1968. The seasonal effects of Federal Reserve policy.

The study analyzes the effects of seasonal changes in monetary operations on the seasonal in the money stock. In addition, the relationships between these operations and seasonal changes in market interest rates and in Real Gross National Product are examined. Simple least squares regression analysis is utilized, and the periods contrasted are the Second World War (1942-1946), the immediate postwar (1947-1951), and the post-Accord period (1952-1965).

LEE NEE YOON, Ph.D. Minnesota 1967. The conventional mortgage loans of savings and loan associations.

### Public Finance; Fiscal Policy

SUSAN R. AGRIA, Ph.D. Chicago 1968. Tax treatment of income from mineral industries: an economic appraisal.

A study of the incentives to invest in mineral industries given by the depletion allowance

and related federal tax provisions with special attention given to the oil and gas, iron, and coal industries. Model developed to estimate these incentives including the effects of severance taxes, differential risk, lease costs, and possible changes in tax law.

DAVID B. ASHBY, Ph.D. Oregon 1968. State and local government demand for cash balances.

EDWARD G. BOEHNE, Ph.D. Indiana 1968. Equalization of state-local fiscal relations: aid to education in Indiana.

Theoretically, a framework for the equalizing of local tax effort as a fiscal objective for state aid is provided. Empirically, the following questions are asked with reference to Indiana: (1) is tax effort equalized with the existing distribution formula; (2) how does the present aid distribution pattern compare with major alternative formulas; (3) what effect does the equalizing of tax effort have on total educational expenditures?

KEITH BRYANT, JR., Ph.D. Alabama 1967. Alvin H. Hansen's contribution to fiscal policy.

HENRY J. CASSIDY, Ph.D. Illinois 1968. Stabilization properties of the payroll tax.

This study examines the characteristics of the wage distribution in the United States and changes in the wage distribution for purposes of evaluating the stabilization properties of the payroll tax. It lays out measures of elasticity of the payroll tax and shows how various exemptions and wage ceilings contribute to elasticity of the tax and its resultant stabilization characteristics over various phases of the business cycle.

ROBERT M. COEN, Ph.D. Northwestern 1967. Tax policy and investment in manufacturing 1954-1966.

SURESHCHANDRA DESAI, Ph.D. California (Los Angeles) 1967. The effectiveness of federal grants in attaining equalization, equity and economic growth: a case study of India.

The quantitative appraisal of the system of federal grants in India in terms of certain selected indices was carried out for 1955-56 and 1960-61. Federal grants were found to be not equalizing, though there was a slight equalizing tendency over time. Their impact in the attainment of equity as between the states was found to be negligible. They were found to be conducive to economic growth in terms of their impact on interstate mobility.

BRADLEY T. GALE, Ph.D. Rutgers 1968. The effect of income elasticity of tax yields on expenditure growth: a state-local analysis.

This study examines the effect of the tax structure of state-local governments on their expenditure growth. It was found that per capita expenditures grow more rapidly in states whose tax revenues increase automatically in response to income growth than they do in states whose tax structures are less elastic. The effect of secular income elasticity on per capita expenditure growth was found to be greatest in states of high income growth as expected.

FRANCIS G. HAYDEN, Ph.D. Texas 1968. Principles and policies of allocating state primary and secondary public educational expenditures.

First, a chapter is devoted to developing a theory of fiscal federalism. Next, the procedure is to move from the general realm of fiscal federalism to the specific realm of state educational expenditures. The traditional approach to state educational expenditures has been concerned with matters such as financial matching devices, equalization grants, fiscal capacity, fiscal effort, and so forth. Here these matters are shown to be theoretically irrelevant and actually frustrating to providing education. Finally, a mathematical appendix depicts the use of mathematics in presenting and analyzing improved expenditure formulas. formity and administrative coordination in reducing administrative problems.

DALE M. HELEN, Ph.D. George Washington 1968. An econometric model of United States government revenues and expenditures.

This dissertation described an aggregate econometric model of the U.S. economy with particular emphasis on the government sectors. The main government sectors include tax receipts, contributions to social insurance funds, transfer payments, and purchases of goods and services at both the federal and state—and—local level. The model which contains 181 endogenous variables was estimated with annual data from the 1947-65 period.

ROBERT E. HICKS, Ph.D. Ohio State 1967. An analysis of the influence of certain fiscal

variables on the success of proposed school tax levies and bond issues for public school support in Ohio.

This dissertation analyzed the influence of eighteen fiscal and socio-economic variables on the decision of the electorate to vote for or against a public school finance proposal. A generalized stepwise regression was used, and included all bond issue and tax levy proposals for 1962 through 1966, a total of 3450. Only the educational level of adults and the average daily attendance in the school district are consistently significant. Fiscal variables are not consistently significant in any category investigated.

PATRICK R. KELSO, Ph.D. Texas 1968. A federally based state income tax as a potential source of revenue for Texas.

The study compared the several policies a state might adopt with regard to conformity to federal income tax codes. The comparison is in terms of the effect on tax yields, distribution of tax burden, and sensitivity to income change. Consideration is also given to the problems of income tax administration and to the effectiveness of state-federal tax conformity and administrative coordination in reducing administrative problems.

MELVYN B. KRAUS, Ph.D. New York 1968. Tax harmonization in the Benelux Economic Union.

PETER B. LUND, Ph.D. California (Berkeley) 1967. Municipal costs arising from business and industry: a case study of San Leandro, California.

NICHOLAS A. MICHAEL, Ph.D. Illinois 1967. Variations in the level of provincial-municipal expenditures in Canada: an econometric analysis.

This study is an attempt to determine those factors which affect per capita expenditures of various functions at the provincial-municipal level in Canada. Variables used with a measure of success in single equation regressions were per capita income, population density, and urbanization. The effect of federal aid upon per capita total expenditures was considered in a two-stage least-squares model. The variables tax effort and per capita revenue of each province were also included in the framework.

NICHOLAS MICHAEL, Ph.D. Illinois 1967. Analysis of property taxation in Alberta.

WILLIAM R. MOFFAT, Ph.D. Harvard 1968. Pricing and the corporation income tax.

Price rules are deduced for industries which act as monopolists pursuing profit maximization, target rate of return, dollar markup, per cent markup, and revenue maximization. Corporation income tax rates are introduced in motivationally logical ways. Yearly data, 1928-1962, indicate profit maximization in textiles and target-rate pricing in rubber. Unit labor and materials costs, and excess demand, are important explanatory variables. Taxes help explain price changes, but are not important for price levels.

ABDUR RAB, Ph.D. Harvard 1968. Personal and business income taxation in Pakistan.

CADWELL L. RAY, Ph.D. Texas 1967. An analysis of the impact of value added taxation with special reference to Texas.

BRUCE R. RIGGS, Ph.D. Wayne State 1968. Stabilization policy and the individual income tax.

GAIL BENNETT SANGREE, Ph.D. Case Western Reserve 1967. An evaluation of the intangible property tax in Ohio.

This is the first study in depth of the Ohio experience with taxing intangibles. The tax is evaluated and recommendations made. Preferential earmarking for public libraries has given Ohio perhaps the nation's best library system. Some justification is found for the charge capital is inequitably and regressively treated. Compliance is found to be excellent for large taxpayers, but 30 per cent of potential revenue from other taxpayers (with over half the liability) is lost from non-compliance.

GERALD SAZAMA, Ph.D. Wisconsin 1967. State government industrial loan programs.

State government industrial loans are granted in two forms direct or guarantee of privately placed loans. The main objective is to determine whether or not state loans have a positive economic impact on states which grant them. Secondary objectives are to evaluate the relative importance of different reasons for their impact and to look at them in perspective of some broader economic and noneconomic questions. Examination of five

states responsible for 86 per cent of the dollar value of loans resulted in finding that all five loan programs had positive net social benefits.

WILLIAM T. SHEER, Ph.D. Minnesota 1967. The burden on capital and the shift of the corporation income tax.

A brief review and discussion of Harberger's article and Tambini's unpublished dissertation are made first. A reexamination of the MM Theorem follows. The main body of this dissertation is built on a general equilibrium model taking into consideration uncertainty or risk. The demand functions for stocks and bonds are derived and certain desirable properties of the supply functions are established. Mathematical properties of the functions are examined. Two theorems are proved which yield the conclusions.

DAVID L. SMITH, Ph.D. Arizona 1968. The response of state and local governments to federal grant-in-aid payments.

This study seeks to determine the expenditure response of state and local governments to federal grants on both a theoretical and empirical basis. A major finding was that federal grants appear to produce a strong income effect that acts to release funds for expenditure on the nonaided functions, rather than drawing funds away from them. In addition, some tentative conclusions regarding the effects of a system of unconditional grants are offered.

JOSEPH R. THOMPSON, Ph.D. Florida 1968. An economic analysis of public expenditure in Honduras: 1925-1963.

EMANUEL TOBIER, Ph.D. New York 1968 New Jersey's subnational fisc: a case study of the taxing and spending policies of state and local governments.

GEORGE I. TREYZ, Ph.D. Cornell 1967. Effects of alternative fiscal policies on the national economy: a flexible econometric approach.

An econometric model of the economy that includes "demand" variables (the observed value plus any change in unfilled orders for that sector of demand) is used to forecast price changes and real values. Conditional probability distribution forecasts are based on simulations that incorporate estimates of the probability distribution of the disturbances. These estimates include adjustments for factors, such as the psychological effects of a particular policy, that would not be captured in mechanical forecasts with the model.

FRANKLIN D. VAN BUEY, Ph.D. Illinois 1967. Structure and administration of the Eastern Nigerian tax system.

The major purpose of this study is to present the first comprehensive description and analysis of the tax system of Eastern Nigeria as it existed until 1966. The major sources of tax revenue of both the regional and local governments are analyzed. A major part of the study is concerned with the personal income tax, which is the major source of tax revenue in Eastern Nigeria. A major finding of the study is that Eastern Nigeria has proved that a personal income tax, properly designed and administered, can produce a substantial amount of revenue in a developing country.

JAMES A. WILDE, Ph.D. Princeton 1968. The stimulatory effect of grants-in-aid.

This study examines the effect of intergovernmental grants on the expenditures of recipient units. Empirical results from the areas of public education and public assistance appear to be compatible with the theoretical model developed. Indications of greater stimulation in the welfare case may be due more to the nature of the expenditure category than to the provisions of the grant.

ALEXANDER C. WISEMAN, Ph.D. Washington 1968. The demand for cigarettes in the United States: implications for state tax policy.

MICHAEL F. ZWEIF, Ph.D. Michigan 1967. Forecasting state tax revenues.

### International Economics

FREDERICK M. ADLER, D.B.A. Harvard 1968. Import substitution, U.S. production abroad, and the U.S. balance of payments.

KENNETH L. BAUGE, Ph.D. Michigan State 1967. Voluntary export restrictions as a foreign commercial policy with special reference to Japanese cotton textiles.

The evaluation of voluntary export controls was analyzed with special reference to Japanese limitations on cotton textiles to the United States. A test of the results of export controls has been made by calculating the elasticity of demand for cotton velveteen in the United States market. By means of multiple linear regression and correlation analysis, a demand elasticity factor was obtained. On the basis of these calculations it became clear that the voluntary export controls imposed by Japan were more restrictive than those that would have been imposed by the United States (at rates proposed by the Tariff Commission).

DWIJARAJ BHATTACHARYA, Ph.D. Wayne State 1968. International liquidity: is there a problem of current and prospective shortage?

HARRY R. BIEDERMAN, Ph.D. Columbia 1968. The influence of decreasing costs on international trade and cooperation in aerospace products.

MARTIN E. BOND, Ph.D. Iowa 1967. Capital movements and international disequilibrium.

ROBERT BONNINGTON, Ph.D. Iowa 1968. Foreign investment inducements: Latin America.

HAROLD L. BRYANT, Ph.D. Cincinnati 1967. Problems of discipline in the international balance of payments.

SHIRLEY P. BURGGRAF, Ph.D. Case Western Reserve 1968. A review of the theory of gains from trade under imperfect competition.

Reviewed are the considerations accepted trade theories give to the gains from trade when the perfect competition assumption is removed. Then the effects on the gains from trade are analyzed as each competitive imperfection is introduced: product differentiation, scale economy and diseconomy, restriction to entry, monopoly, and imperfect knowledge.

PETER B. CLARK, Ph.D. Mass. Inst. Technology 1967. Optimum international reserves.

This thesis represents an attempt to relate some of the factors in a systematic fashion which affect reserve needs. A two-period Fisherine model is developed in which international reserves function as a capital good and a transformation curve for reserves is derived. Optimum reserves are derived as a function of the frequency of balance-of-payments deficits, the opportunity cost of reserves, and the type of response which is made to a payments deficit, the preferences of the country with respect to present and future use of resources, interest payments, and capital movements. The analysis is extended to a model which specified the way in which reserves and the speed of adjustment both serve to maintain a certain degree of security against incurring the costs of illiquidity.

MELVYN R. COPEN, D.B.A. Harvard 1967. The management of U.S. manufacturing subsidiaries in a developing nation: India.

GEORGE W. DICK, JR., Ph.D. Pennsylvania 1968. Effects of petroleum import liberalization on employment and discovery rates in the United States.

Data derived from a questionnaire submitted to all U.S. refineries, together with data from various other sources, are analyzed to arrive at an evaluation regarding the effects of petroleum import liberalization on domestic oil prices, employment, and discovery rates. It is concluded that the price would decline about 25 per cent (maximum), total employment (ex multiplier effects) would decline by about 30,000, and the discovery rate would fall by less than 10 per cent.

ALFRED J. FIELD, JR., Ph.D. Iowa (Ames) 1967. A multi-regional, multi-commodity descriptive and econometric analysis of world trade, 1953-1964.

BRUCE W. FINLEY, Ph.D. Pennsylvania State 1967. Tanker capacity and crude oil imports in Western Europe 1975 prospects.

This study investigates changes in the Western European crude oil supply pattern that have occurred since the Suez Crisis of 1956-1957 and assesses some of these changes as to their possible impact on tanker requirements for crude oil imports in 1975.

EDWIN H. FLYNN, Ph.D. Indiana 1967. The European Common Market: its production, trade, and welfare effects.

This thesis states the overall economic impact of the EEC by applying theories of customs union and economic changes in patterns of specialization, protection, and competition. EEC gains so far observed reflect merely initial static welfare advantages of customs

union. The incomplete nature of the integration has prevented realization of potentially extensive scale, efficiency, and competitive advantages. Further commercial and financial policy integration is necessary. American investment to date has been the greatest stimulus to industrial restructuring. Agricultural policy, one of co-ordinated protection rather than integration, results in relatively high cost to community consumers. Incomplete integration limits positive world welfare effects which might otherwise accrue. Specific external welfare effects include pressure on other countries to associate with the community or to establish competitive trading blocs with inherent welfare disadvantages of regionalism.

KLAUS FRIEDRICH, Ph.D. Cornell 1968. The Euro-dollar system.

The historical-institutional basis of the Euro-dollar system. A model, incorporating both inter-bank intermediation and credit creation through the system. Euro-dollar data for the major financial centers, presented in circular flow form with special reference to changes caused by the 1965 guidelines. Policy applications in the Euro-dollar market; the Italian case of adjusting private banks' external positions to the needs of the balance of payments.

K. GEORGE GABRIEL, D.B.A. Harvard 1967. The gains to the local economy from the foreign-owned primary export industry: the case of oil in Venezuela.

PAUL GAEBELIN, Ph.D. Claremont 1968. Devaluation under full employment and inflation: the case of Israel.

The experience of Israel, following the devaluation of the pound in February, 1962, confirms the essential validity of the modern theory of the balance of payments adjustment, involving a synthesis of the elasticities and absorption approaches to the problem. The trade balance first improved and then deteriorated, as an initially favorable relative price effect of devaluation was overwhelmed by an unfavorable income effect.

ALAN L. GINSBURG, Ph.D. Michigan 1967. A regional covariance analysis of the determinants of U.S. and U.K. exports during the postwar period.

JOHN R. GRIFFITH, JR., Ph.D. Kansas 1968. The effect of the Interest Equalization Tax Extension Act on purchases of long term bonds of selected countries marketed in the United States, January 1959-March 1966.

DEMOS P. HADJITZANIS, Ph.D. Minnesota 1967. The demand for international reserves: a cross-section analysis.

This is an analysis of the factors determining the official demand for international reserves, (R). One of the hypotheses tested is that R are related positively with total international payments, the variability of R, the degree of development, and inversely with the borrowing capacity. The significance of money supply, commercial bank holdings of R, foreign liabilities, and exchange rate flexibility is also explored.

JAMES A. HANSON, Ph.D. Yale 1967. The terms of trade and economic growth.

DONALD G. HECKERMAN, Ph.D. Mass. Inst. Technology 1967. Models of the balance of payments and standards for adjustment.

A model of two economies is developed which is able to portray private capital movements as arising naturally out of conditions in national financial markets. For the case in which adjustment costs are zero, a set of standards is suggested which results in a more efficient solution than that provided by the prevailing balance of payments standard. The new set of standards emphasizes the importance of achieving an appropriate current-account balance.

DONALD S. HENLEY, D.B.A. Harvard 1967. Regional trade and market performance: a study of the Central American common market.

JANOS HORVATH, Ph.D. Columbia 1967. A comparative appraisal of economic aid.

This study analyzes the economic aid programs of the Soviet Union as compared with those of the United States. After a recount of Soviet aid projects, two tests are made. First, the foreign trade data of the Soviet-aid-recipients show expansion with the USSR and the USA alike. Second, the designed indicators reveal that beneficiaries of Soviet aid enhanced their public sector while countries receiving no Soviet aid expanded their private sector.

VICTOR E. JACOBS, Ph.D. Kansas State 1968. A theory of international commodity trade as a cause of divergence in international rates of economic development.

The dynamic effects of international commodity trade on rates of factor creation (or depletion) are analyzed when trade is opened between idealized developed and underdeveloped countries. Factor proportions differences peculiarly consistent with differing stages of development are postulated and the effects of trade analyzed via Heckscher-Ohlin factor price effects and resulting responses of factor quanta. Divergence in developmental and welfare paths are the contended result.

HUGO M. KAUFMANN, Ph.D. Columbia 1968. The German revaluation debate 1959-1961: a chapter in political economy.

WARREN J. KEEGAN, D.B.A. Harvard 1967. Scanning the international business environment: a study of the information acquisition process.

SWEE JOO KHOO, Ph.D. Cornell 1967. Malayan exports: instability and prospects.

SABASTIAAN J. KLEU, D.B.A. Harvard 1967. Import substitution in the South African automobile industry.

GERALD M. LAGE, Ph.D. Minnesota 1967. The welfare cost of trade restrictions: a linear programming analysis.

The purpose of this dissertation is to provide further evidence on the efficiency losses due to trade restrictions. A linear programming model is developed which, when applied to the Japanese economy of 1955, yields estimates of the production cost of their restrictions in the range of three-tenths to one per cent of national income. These estimates are larger, but not substantially so, than previously reported losses.

ALTON D. LAW, Ph.D. Rutgers 1968. Aspects of the theory and practice of international commodity agreements.

A study of the development of problems of instability and price trend in primary commodities and of control activity of the commodity agreement form was undertaken, emphasizing tin, coffee, rubber, sugar, wheat, and cocoa. Examination of historical attitudes toward control activity shows that the supporting pressure has turned from stabilization toward resisting trends. This basis holds less economic justifiability and promise. Problems of compliance, funding, adjustment, and reallocation become enlarged—not solved—by this approach.

J. CLARK LEITH, Ph.D. Wisconsin 1967. Effective rates of protection: analysis and an empirical test.

The assumptions of infinite supply and zero substitution elasticities of the original effective protection model are relaxed. Allowing for less than infinitely elastic supplies of nontradable inputs or of foreign tradables reduces effective protection. Substitution between inputs increases the effective protective rate by permitting economizing in production. A hypothetical and an empirical example (for Taiwan) demonstrate the sensitivity of the effective protective rate to these modifications.

PAUL MAREK, Ph.D. Pennsylvania 1968. Foreign trade prices in the Soviet bloc: a theoretical and empirical study.

This study calculates foreign trade prices in Hungary's trade with three partners. Export prices are considered in conjunction with import prices because a COMECON country's trade is essentially bilateral barter. World market prices are used as a base of comparison because COMECON has not yet evolved its own set of prices. Calculations indicate that Hungary imported at less and received higher than world market prices from Poland; imported from the USSR and Austria at world market prices but exported to USSR and Austria about 10 per cent below world market levels.

GEORGE W. MCKENZIE, Ph.D. California (Berkeley) 1967. International economic stability: an essay in positive economics.

R. H. MASON, Ph.D. Stanford 1967. An analysis of benefits from U.S. direct foreign investments in less-developed areas.

ROBERT A. MINICK, JR., Ph.D. Texas 1967. An analysis of the contribution of foreign investment to the Brazilian economy.

The historical role of foreign investment in the process of economic development of the Brazilian economy is examined. It is concluded that the contribution of foreign investment has been negligible in Brazil.



JAMES S. MOOSE, Ph.D. Harvard 1968. U.S. direct investment abroad in manufacturing and petroleum—a recursive model.

This thesis develops a theory to explain three aspects of U.S. direct investment abroad: plant and equipment investment, earnings retention, and direct capital outflows. The estimating equations for the theory are set up in the form of a recursive model. Slightly different models are developed for manufacturing and downstream petroleum.

SOTIRIOS G. MOUSSOURIS, D.B.A. Harvard 1967. Export horizons of Greek industries.

PARVIZ PARSIA, Ph.D. Oklahoma 1968. The controversy over international monetary system: a critical review of the plans for the reform of the system.

Reform of the international monetary system attempts an evaluation of alternative solutions for the reform of the system, and in view of the practical aspects of the reform, establishment of domestic objectives of growth and employment in the present world, and a look into the data concludes that creation of more international reserves under effective supervision of an international agency is the most promising and the least damaging direction in which the reform should develop.

MARTIN F. J. PRACHOWNY, Ph.D. Michigan 1967. A structural model of the foreign sector of the U.S. economy.

PEJAVAR R. RAO, Ph.D. Iowa (Ames) 1967. Effect of world trade on economic development.

DAVID J. RAPPORT, Ph.D. Michigan 1967. An economic analysis of barriers to world trade in cotton textiles, 1953-64.

BARRY K. ROGSTAD, Ph.D. Brown 1968. Long-run international capital movements: impact on the Canadian economy.

Employing the experience of Canada during the 1900-15 and 1948-62 periods, this dissertation provides a consistent explanation of export behavior and inflows of foreign capital. It is shown that within a comparatively small country, a capital intensive export sector, with imports providing the necessary capital goods, is capable of circumventing the observed inconsistencies of the classical explanation. Several exogenous disturbances affecting capital productivity in export production are examined under both static and dynamic frameworks.

JORGE SALAZAR, Ph.D. California (Berkeley) 1967. Primary type export activities as leading sectors in economic development: the Venezuelan case.

DONALD J. SCHILLING, Ph.D. North Carolina 1968. Devaluation risk and interest rate parity theory.

It is hypothesized that speculative risk in the foreign exchange markets is primarily devaluation risk. A static model of forward market equilibrium is derived assuming binary and asymmetric devaluation risk and using the Bernoulli principle of wealth maximization. The implications of the model include the usual interest rate parity conclusions as one of three cases. Empirical tests of the risk hypothesis are conducted and policy implications of the model and the tests are discussed.

LOIS E. STEKLER, Ph.D. Yale 1968. Effect of U.S. business fluctuations on imports of primary commodities.

JOSIAH D. STRYKER, Ph.D. Columbia 1967. United States and Canadian manufacturing production and exports.

The effect on exports of the determinants of the structure of comparative costs is examined in a two-country, multi-commodity model, utilizing the concept of the production function with technological progress incorporated as an exponential trend variable. Empirical tests are employed, using data for twenty-four manufacturing industries in the United States and Canada over the period 1949-1964. It is found that changes in the structure of exports for both countries are significantly related to rates of change of technology and relative factor prices and may also be related to the exploitation of economies of scale.

AUGUSTINE H. H. TAN, Ph.D. Stanford 1968. Differential protection, economic indices, and optimal trade policies.

A theoretical dissertation, involving the construction of trade models incorporating inter-industry flows, the use of imported input and nontraded goods. These models are used to examine index number problems arising from differential protection, the measurement and

theory of effective protective rates, and optimal trade policies to attain noneconomic objectives.

RODRIGUE TREMBLAY, Ph.D. Stanford 1968. The Euro-dollar market: its role in financial intermediation and economic growth.

EDWIN M. TRUMAN, Ph.D. Yale 1967. The European Economic Community: trade creation and trade diversion.

RENE I. VANDENDRIES, Ph.D. Iowa State (Ames) 1967. Foreign trade and the economic development of Peru.

HERMAN R. VON BERTRAB-ERDMANN, Ph.D. Texas 1968. The transfer of technology: a case study of European private enterprises having operations in Latin America, with special emphasis on Mexico.

This dissertation is based chiefly upon interviews with 73 European or European-connected enterprises having operations in Latin America. Adaptation of techniques to suit factor scarcity and market size is achieved in three different ways: by use of older methods; by increased labor intensity in ancillary functions; by the redesigning of basic processes. Technological transfer implies assimilation through training. Three different sets of training indexes which try to quantify the training effort of firms are devised. The training effort to these firms is comparatively high. Inflow of technical knowledge into Mexico, as measured by royalty and technical assistance payments has increased rapidly since 1950.

HAROLD L. VOTEX, JR., Ph.D. California (Berkeley) 1968. A one- and a two-country dynamic model to consider the simultaneous achievement of internal and external balance.

THOMAS D. WILLETT, Ph.D. Virginia 1967. A portfolio theory of international short-term capital movements.

A theoretical analysis of private short-term capital movements is presented based upon a stock-adjustment model with portfolio growth. Recent empirical studies of U.S. capital flows are criticized and the importance of identification problems is stressed. It is argued that high-interest rate policies can bring about only a short-run improvement in the U.S. balance of payments and that for this purpose they are a high cost method of finance.

PATRICK YEUNG, Ph.D. Claremont 1967. Toward a pure theory of entrepot trade.

A theoretical explanation of the phenomenon of entrepot trade. The entrepot is defined with the assistance of the "significant enterprise approach" of regional analysis. A geometric model is then built upon the familiar two-dimensional offer-curve version of the pure theory of international trade. It is used to analyze the effects of factor endowments, changes in supply and demand, growth, transport costs, tariffs, and competition by means of comparative statics. A number of theoretical, normative, and operational implications are attributed to the model.

### **Business Finance; Investment and Security Markets; Insurance**

ENRIQUE R. ARZAC, Ph.D. Columbia 1968. Investment selection under probabilistic conditions.

This dissertation studies the problem of resource allocation in stochastic investment processes. It includes model definition, criteria for truncating the planning horizon, probabilistic specifications of the model, distribution-free specifications with inequalities for the sum of partly dependent random variables, approximation of optimal strategies by linear decision rules, linearization of the resulting chance-constrained programming problems, an iterative parametric procedure for nonlinear programming, dual evaluators, Bayesian inference models for multinormal processes, and a survey and evaluation of integer programming algorithms.

ROGER A. COSSABOOM, D.B.A. Harvard 1968. Segmental financing of corporate conglomerates.

ANTHONY J. CURLEY, Ph.D. Pennsylvania 1967. A stochastic simulation of the personal investment decision.

This study focuses on the accumulation of wealth by the individual. The methodology selected is the construction and operation of a simulation model of this process. The investment decision involves two major segments, time preference and risk preference; model

experiments are directed toward the sensitivity of wealth outcomes to variations in behavioral assumptions concerning each of these. The necessity that both preference systems be considered concurrently is also demonstrated.

ROBERT G. EDWARDS, JR., Ph.D. Arkansas 1968. Some selected estate planning aspects of the variable annuity.

JACK E. GAUMONTZ, Ph.D. Stanford 1967. Investment diversification under uncertainty: an examination of the number of securities in a diversified portfolio.

WILSON R. HAIG, Ph.D. Alabama 1967. Negotiable time certificates of deposit: their impact on corporate cash management, 1961-1965.

The negotiable time certificate of deposit has experienced since its introduction in 1961 a remarkable rise to prominence in the short-term investment portfolio of the non-financial corporation. Although Treasury obligations still dominate the portfolio, by 1965 CD's constituted nearly one-fourth of the aggregate portfolio studied. A pervasive use of CD's was noted in all industry lines. It appears that portfolio managers are more actively seeking higher investment yields.

JOHN C. HAMBOR, Ph.D. Michigan 1968. Capital appropriations and business fixed investment in manufacturing: an econometric analysis.

HARRISON N. HOPFES, Ph.D. American 1968. An evaluation of selected, normative models of equity valuation.

This dissertation presents a systematic evaluation of 18 normative, equity valuation models that embody three valuation viewpoints (dividends alone, dividends and earnings, earnings alone), three types of income-stream representations (exponential, modified exponential, linear), and two risk-compensation techniques (risk-adjusted discount rates, certainty equivalents). In evaluating the relative merits of each of the valuation viewpoints, income-stream representations, and risk-compensation techniques, historical financial data for 70 companies were analyzed for the 20-year period, 1947-1966.

RONALD J. HUEFNER, Ph.D. Cornell 1968. Capital investment decisions and uncertainty: sensitivity analysis of the present value model and evaluation of the treatment of uncertainty.

Sensitivity analysis is applied to the present value model to determine the effects upon the value measure of errors in the estimation of the input variables (cash flow, life, discount rate). The results are used to assess the effect of each of several methods which have been suggested for dealing with the problem of uncertainty.

SANFORD R. KAEN, Ph.D. Cincinnati 1967. An evaluation of the real estate investment trust.

FRANK R. KELLER, D.B.A. Harvard 1967. The behavior of individuals in security investment decisions.

ALVIN K. KLEVORICK, Ph.D. Princeton 1967. Capital budgeting under risk: a mathematical-programming approach.

The allocation of fixed budget dollars, in each of several time periods, among competing investment proposals is considered for a firm operating in a specific risk and imperfect-capital-market environment. The general question of attitudes toward risk in multiperiod decision-making is discussed. A programming model of capital budgeting under certainty is constructed and then reconsidered in light of the presence of risk. A procedure for solving the resulting mixed-integer programming model of capital budgeting under risk is presented and lent an economic interpretation.

JOHN G. McDONALD, Ph.D. Stanford 1967. Valuation of common stock and the cost of equity capital.

WESLEY W. MARPLE, JR., D.B.A. Harvard 1967. Financial aspects of voluntary divestitures in large industrial companies.

MITSURU MISAWA, Ph.D. Michigan 1967. The historical and comparative study of the post-war Japanese securities markets in the light of law and business practice.

GEORGE G. C. PARKER, Ph.D. Stanford 1967. Capital budgeting and financial analyses in underdeveloped countries.

J. R. PETERS, Ph.D. McGill 1968. The economics of private placements in Canada.

The study describes the primary market for privately placed and publicly offered corporate bonds in Canada. The functions and characteristics of the capital market are described and concepts of efficiency are defined. The study attempts to measure the operational and allocational efficiency of the private placement and public issue markets and supplements these measures with an assessment of the influence of the investment dealer business and the institutional lenders upon operational efficiency. Lastly, the study measures the allocational efficiency of the corporate bond market and considers the many qualitative influences upon allocational efficiency. The operational and allocational inefficiencies in the private placement and public issue market are shown to be small in relation to the size of these markets, but several recommendations are made. Among these recommendations are the use of private regulations to improve efficiency and, where needed, the use of public policy measures made effective through securities legislation.

THOMAS F. POGUE, Ph.D. Yale 1968. The corporate dividend decision: a cross section study of the relationship between dividends and investment.

ROBERT C. PUTH, Ph.D. Northwestern 1967. Supreme life: the history of a Negro life insurance company.

GARY R. STONE, Ph.D. Stanford 1967. An analysis of the investment nature of convertible bonds.

CHARLES A. TRITSCHLER, Ph.D. Stanford 1967. Empirical research in the implementation of current cost based financial statement for the measurement of holding gains and losses.

ISRAEL UNTERMAN, D.B.A. Harvard 1968. A comparative analysis of the strategies of new life insurance companies.

GARY WENGLOWSKI, Ph.D. Pennsylvania 1967. Estimates of the cost of capital and the market's valuation of the average electric firm: 1954-64.

CHARLES WHEAT, Ph.D. Arkansas 1968. The New Haven case: a study of changing patterns in public policy and capital formation.

CHARLES W. YOUNG, D.B.A. Harvard 1968. Linear programming and short-term financial planning.

GIANNI G. ZANDANO, Ph.D. Yale 1967. Business firms liquidity: an Italian experience.

### **Business Organization; Managerial Economics; Marketing; Accounting**

ROBERT F. ABBANAT, D.B.A. Harvard 1967. Strategies of size.

MANUEL S. ALBA, Ph.D. Northwestern 1968. Microanalysis of the socio-dynamic of diffusion of innovation.

Author seeks to demonstrate the feasibility of simulating the process of diffusion of innovation. Based on data from a study of the rate of adoption of touch-tone telephones in Deerfield, Illinois, Alba simulates the passage of a population of one hundred persons from non-knowers to knowers to knower-adopters. The change in adopter status is affected by the quality of mass communication, word-of-mouth influence, and traits of persons. The events are generated stochastically. The simulation produced a good fit to actual adoption times by individuals and a moderately good fit to the cumulative adoption rates.

ABD-ELMEGID ALI RAGAB, Ph.D. American 1967. A study of the concept of research underlying marketing research education.

The purpose was to evaluate the concept of research underlying marketing research education in American collegiate education. As derived from surveying course offerings, this concept was contrasted against these criteria: natural and social science's concept of research, business needs, and the goals of university education for business. Results: considerable deviation from the concept of research in science, improbability of fulfilling business needs, and incompatibility with the goals of university education. Another concept was proposed.

BRANDT R. ALLEN, D.B.A. Harvard 1967. The use of time-shared computer programs in

variables affecting the procurement, processing, and distribution functions of the firm.

**NORMAN C. LERNER**, Ph.D. American 1968. Evaluation and development of forecasting techniques for U.S. international telecommunications traffic.

Separate mathematical models are developed and tested for forecasting and explaining U.S.-Europe Telephone, Telegraph, Telex for the years 1952-1965. Independent variables include trade, travel, investment, prices, business hours and number of voice circuits. The dynamics of the industry are investigated from alternative service, call, revenue and geographic distribution points of view to set an empirical framework for forecasting. The impact of technological innovation and the economic aspects of forecasting provide the relevant theoretical framework.

**EUNICE J. LORTIE**, D.B.A. Harvard 1967. Varieties of autonomy and rewards in work: the case of the commercial artist.

**ALAN MACDONALD**, D.B.A. Oregon 1968. Communicating with middle and upper class Negroes with particular emphasis on media attitudes of generalized influentials.

This paper tested two hypotheses generally advanced in studies of the media attitudes of Negroes: (1) "white" consumer magazines tend to be evaluated more highly than similar Negro magazines by upper and middle class Negroes; (2) "white" consumer magazines will also be regarded as more potent by the same group. Using both depth interviews and the semantic differential to determine and sort the attitudes of selected "influentials," the writer found little significant support for either hypothesis.

**JOSEPH B. MASON**, Ph.D. Alabama 1967. The real differences in demographic and economic characteristics between and among urban and nonurban micro-geographic areas: a spatial and temporal framework.

This research applied discriminant analysis to seemingly homogeneous micro-geographic areas to test for statistical differences in household ecological data and yielded insights into pertinent variables for constructing a retail potential model. Variables tested were age, education, and occupation of household head; household income; number of drivers' licenses; and number of motor vehicles; number of adults and number of children in household; and number of years the family had occupied its present home.

**ROBERT C. MATTHES**, Ph.D. Purdue 1967. A management information and control system for hog fabrication.

The study was designed to improve profit performances of pork operations by identifying the relevant decision variables, evaluating decision alternatives, and determining an optimum course of action. Actual data from the case firm were used to construct the various components in the system.

**JOHN D. McCONNELL**, Ph.D. Stanford 1967. A behavioral study of the development and persistence of brand loyalty for a consumer product.

**FRANK S. McLAUGHLIN, JR.**, Ph.D. Florida 1967. An entrepreneurial discretion model: theory and implication.

**LEE R. MORRIS**, D.B.A. Harvard 1967. Cost/effectiveness—the current state of the art.

**MICHAEL S. S. MORTON**, D.B.A. Harvard 1967. Computer-driven visual display devices—their impact on the management decision-making process.

**PETER L. MULLINS**, Ph.D. Stanford 1967. Resource allocation, budgeting and project selection for research and development activities.

**ROBERT W. MULLINS**, D.B.A. Harvard 1967. The role of the purchasing officer in the flow of technical information.

**ROBERT E. M. NOURSE**, D.B.A. Harvard 1967. Demand for new products in processed food industries.

**RUSSELL W. OLIVE**, D.B.A. Harvard 1967. The evaluation of subcontractor quality capability by survey.

**DAVID L. RADOS**, Ph.D. Stanford 1968. The advertising decision in a large supermarket.

**T. R. RAMAKRISHNAN**, Ph.D. American 1967. Identification of the elements of a control system based on evaluation of management control systems employed by selected R & D organizations engaged in government contract work.

The value of this research lies in determination of the different management control systems used by R & D organizations performing government contracts, and establishing relationships, if any, between systems prescribed by government agencies and those used by the private performing organizations internally. Further, based on an evaluation of the existing systems, the common elements of a control system applicable to R & D operations have been identified.

LAWRENCE S. REVSINE, Ph.D. Northwestern 1968. Replacement cost reports to investors: a relevance analysis.

Author establishes a reporting framework and examines the particular information needs of investors. Based on a detailed analysis, the "different income for different purposes" concept is reaffirmed and the appropriateness of "general purpose" reports to third parties is denied. The name "relevant income approach" is bestowed on an analytical process which could enable accounting theorists to develop user-relevant external reports. The replacement cost income concept is thoroughly examined and the two objectives of this latter concept are determined to be invalid. The "indirect measurement hypothesis" is demonstrated to be fallacious, and the dynamic averaging problem is considered in rejecting the feasibility of a current operating profit approach.

SANDRA C. RICEARD, Ph.D. Texas 1968. Industrial management practices and management education in West Pakistan: a study of their relationship in the industrial development process.

An inquiry into the relationship of industrial management practices and management education in West Pakistan's industrial development. Interviews were conducted with managers of 30 Karachi plants to discover their managerial policies, practices, and problems and with directors of institutions that offered management courses. The conclusion was that government policies and actions obviated the potential role of management education in improving industrial operations because government policies permitted profitable operations in spite of production inefficiencies. When production management techniques were applied by experienced managers, results were reportedly highly satisfactory, but application of Western-developed organizational relationships and behavioral concepts provided inconclusive results.

THOMAS S. ROBERTSON, Ph.D. Northwestern 1967. An analysis of innovative behavior and its determinants.

Author seeks to explore innovative behavior with reference to predispositional factors in individuals and dependence on exposure to communications flow. Factors shown related to early adoption of a telephonic innovation are: (1) venturesomeness, (2) social integration, (3) low cosmopolitanism, (4) social mobility, (5) privilegedness, (6) interest polymorphism, and (7) certain psychological variables.

WILLIAM R. ROY, Ph.D. Michigan 1967. Institutional constraints in the marketing of new plumbing products.

MALCOLM S. SALTER, D.B.A. Harvard 1968. Stages of corporate development: implications for management control.

HOWARD P. SANDERS, Ph.D. Florida 1967. A study of various measurement bases and their effect on periodic income determination.

ARTHUR A. SCHOENWALD, D.B.A. Harvard 1968. Current accounting practices in financial communication.

LLOYD SEATON, Ph.D. Arkansas 1968. An inquiry into the conceptual problems of depreciation and depreciation accounting.

S. PRAKASH SETHI, Ph.D. Columbia 1968. Buyer behavior in an experimental situation.

An investigation into the mediating effects of socio-psychological variables between advertising stimulus and brand loyalty. The study was designed to measure: (1) the relationship between socio-economic (SES) and product (PC) characteristics and brand loyalty, and (2) the effect of "pulse" versus "continuous" TV advertising on the purchase behavior of the panel households—for one brand of analgesics—of the Milwaukee Advertising Laboratory. Findings: SES variables were found insignificant, PC variables highly significant in explaining variances in brand loyalty. "Pulse" advertising—after initial suc-

cesses—was consistently and cumulatively less effective than “continuous” advertising.

NICOLAI SIEMENS, D.B.A. Oregon 1968. Analysis of selected industrial decision rules in a dynamic environment by means of computer simulation.

The effects of three decision rules—economic order quantity, production control, and a modified information system permitting access to retail sales data—on the stability of an industrial production distribution system to growth were evaluated by simulating a typical operation under the influence of each of the rules. The EOQ seemed to distort flow rate of orders; production control finally slowed demand; but use of sales data seemed to offset these defects.

RONALD I. SIMON, Ph.D. Columbia 1968. The financial analysis of uncertainty in major investment projects.

The basic hypothesis of the dissertation is that the size relationship between a prospective investment project and the firm considering it has an important bearing on the amount of uncertainty in the decision and should influence the method for dealing with that uncertainty when making the decision. For major projects, i.e., those projects large enough to affect the future development of the firm, the usual techniques are inadequate. The dissertation describes a procedure employing various types of financial analysis to better organize the data about a major project and firm so that the decision-maker is aware of the causes of the uncertainty and can take steps to protect the firm prior to undertaking the project. The objective is to improve the judgments that must be made—not to provide a substitute for such judgments.

HENRY F. STABLER, Ph.D. Alabama 1968. A study of selected contributions of George O. May to accounting thought.

The purpose of this study was to inquire as to the contributions made by George O. May to the development of accounting thought relative to commercial enterprises. The objectives were to develop an understanding of May's philosophy, to recognize his thoughts and to organize them by subject matter. It demonstrated May's influence on the development of current thought by showing how his views have carried over into the official pronouncements of the American Institute of Accountants and how they continue to be reflected in current pronouncements of the American Institute of Certified Public Accountants.

JOHN O. SUMMERS, Ph.D. Purdue 1968. The identity of the women's clothing fashion transmitter.

STERLING S. SUTTON, Ph.D. George Washington 1968. An evaluation of investment criteria.

Baumol and Quandt's analysis of capital rationing suggests that McKean's criterion must be abandoned for a utility formulation. A linear programming version of the multi-period Fisher model is presented. Multiplier values of the internal rate are removed as a logical objection. Fisher's “principle of repayment” is restated as a dual problem, connecting time preferences and financial transactions.

RICHARD D. TEACH, Ph.D. Purdue 1968. Laboratory experiments for measuring the demand for consumer goods.

EUGENE E. TEEPLE, D.B.A. Oregon 1968. An appraisal of the applicability of the marketing concept as a tool with which to seek a solution to a position in outdoor recreation management.

This thesis investigated whether families that used developed campsites fell into identifiable groups, and if so, what criteria effectively sorted the groups. Interviews with families selected randomly suggested that the reasons for camping were the best basis for classification. Four reasons emerged: weekend excursion, weekend fishing, major vacation, and substitute for commercial accommodations. Knowledge about this grouping should govern future campsite development, public or private.

JOE A. THORNE, Ph.D. Alabama 1967. The influence of federal income taxation on selected aspects of accounting practices and reports.

LEON W. TRANSEAU, Ph.D. American 1968. The possible use of a systems approach in balancing intermittent-flow production lines.

This dissertation presents a system for balancing intermittent-flow production lines where there is the use of in-process inventory banks and reassignment of workers between operations as inventory levels change.

A generalized system was developed and evaluated using a computer model that simulated production line flow and measured the degree of balance achieved. A case study was made in which the system developed was compared with existing methods.

ARTHUR H. WALKER, D.B.A. Harvard 1967. Behavioral consequences of contrasting patterns of organization.

ROY H. WILLIAMS, Ph.D. Alabama 1967. A simulation study of a production scheduling problem in the carpet textile industry.

TERRY YU-HSIEN YU, Ph.D. Purdue 1957. Analysis of factors affecting the optimum size and number of country elevators in Indiana.

This study had the objective of determining the optimum size and number of country elevators in Indiana from an aggregate and firm standpoint. The model used in this analysis was basically a modification of earlier single product models with emphasis being placed on multiproduct facilities. Potential cost-savings to be gained from expansions of size of business appeared to be substantial.

### Industrial Organization; Government and Business; Industry Studies

A. MICHAEL AGAPOS, Ph.D. Case Western Reserve 1967. The economics of renegotiation in the aircraft/aerospace industries.

The problem of controlling profits and business practices in government contracts with the aircraft/aerospace industry involves rapid technological change and often emergency conditions. Risks related to subsidies, contract cancellation, and uncertain renegotiation procedures are analyzed. The net worth concept as applied to six statutory practices is found lax in many respects, particularly in stifling efficiency and promoting monopolistic practices. A weighted guideline proposal is made, assuming uniformly applied specified goals of government procurement.

WARREN E. BANKS, JR., Ph.D. Arkansas 1968. An inquiry into the growth factors and financial policies of International Business Machines Corporation and into the possibility and the probability of the company's continued dominance of the electronic data processing industry.

GARY M. BROEMSER, Ph.D. Stanford 1968. Competitive bidding in the construction industry.

ARTHUR E. BUCKLEY, Ph.D. Alabama 1967. The evolution and development of the local service airline function.

JOHN T. BURGESS, Ph.D. Washington (St. Louis) 1967. An economic analysis of research and development procurement: the NASA subcontract program.

This study postulates that the geographic distribution of research and development subcontract procurement is a relatively stable function of the technical and research efforts necessary to perform the prime and subcontract activities, the geographic location of the contractor, and the industrial classification of the work performed. NASA first and second-tier subcontract procurement patterns for the period January, 1962 through June, 1966, are examined. The feasibility of forecasting regional subcontract distributions is discussed.

SHERMAN F. CARTER, Ph.D. American 1968. An analysis of the influence of the evolution of the Department of Defense on the role of the Secretary of the Army: a case study in organization and management.

Through historical methodology, this study traces changes in the authority, functions, and responsibility of the position of Secretary of the Army as the power of the Office of the Secretary of Defense increased and its control permeated all army activities. The study concludes that the Secretary of the Army continues to perform useful functions and cites problems relating to the organization and management of the Department of Defense.



EDWIN G. CAUDILL, Ph.D. American 1968. Regulatory policy, railroad consolidation, and transportation efficiency.

The development of the regulatory policies pertaining to the railroads is outlined against the background of historic legislative enactments. The regulatory policy is evaluated critically, particularly in respect to the most recent consolidation cycle from 1957 to 1967. The deficiencies of the current policy, in terms of transportation efficiency, are emphasized and the specific need for objective legislation is a supported primary conclusion.

RODERICK W. CLARKE, Ph.D. Stanford 1968. Innovation in liquid propellant rocket technology.

DAVID W. COBIA, Ph.D. Purdue 1967. External growth (mergers and acquisitions) of 35 dominant grain processing and merchandising firms in the North Central region during the 1940-1963 period.

HAROLD A. COHEN, Ph.D. Cornell 1967. Costs and efficiency: a study of short-term general hospitals.

The main theoretical argument is that the invisible hand cannot be expected to lead the hospital industry to an equilibrium position characterized by a socially efficient use of hospital resources. Therefore, a conscious effort, or "visible hand," is required to achieve that end. First, those aspects of the hospital industry which are most likely to contribute to inefficient resource use are examined. Then costs associated with three areas of hospital decision-making are examined.

ALBERT L. DARTNELL, Ph.D. McGill 1968. The transportation of freight by road in Canada.

The thesis examines the Canadian trucking industry and forecasts possible growth. In the past four decades, Canadian trucking has increased considerably. Road and rail competition has been keen, especially for higher-valued products. Road service advantage has been pitted against rail economic advantage. Road transport tends to be the shorter-haul carrier, while rail tends to be the longer-haul carrier. The National Transportation Act, designed to foster competitive control of transportation to the greatest degree possible, appears to be more favorable than adverse toward road transport. Federal labor and safety legislation has, and will, increase costs for the industry but technological and other changes would appear to offer benefits. Further, the industry presents a fairly favorable financial situation. A statistical projection suggests a 109.5 per cent increase in inter-city net ton miles from 1965 to 1972, and a 79.0 per cent increase in urban net ton miles from 1963 and 1972.

ARTHUR X. DEEGAN, Ph.D. Michigan 1967. Delegation and efficiency rankings of a select sample of church executives: a correlation study.

ROSS D. ECKERT, Ph.D. California (Los Angeles) 1968. Regulatory commission behavior: taxi franchising in Los Angeles and other cities.

This study analyzes a problem of public regulation in terms of regulators' maximizing their utilities subject to certain institutional constraints that make it more costly (or less rewarding) for them to take various options. An explanation is offered for why regulatory commissions—as opposed to bureaucratic agencies—find it more rewarding to grant monopoly franchises. Implications are derived and tested with data collected from regulated taxi markets in thirty-six U.S. cities, particularly Los Angeles.

CARL ETS, Ph.D. City University (New York) 1968. The 1919-1930 merger movement in American industry.

This is a study of the 1919-1930 merger wave, the second, and least documented, of the three major merger waves. Annual and subannual levels of merger activity are measured by the number and value of disappearing firms, and classified by industry, type of integration and merger process. The data are used to examine the effects of the existing antitrust legislation, and to provide a more definitive comparison with patterns of merger activity in later periods. Interindustry differences in merger activity are found to be positively correlated with industry growth rates.

ROBERT B. ELVER, Ph.D. Pennsylvania State 1967. Competition in the Canadian primary steel industry, 1945-1966.

The economic problem studied is the existence of effective competition. The problem is

identified by analysis of markets and plant-size relationships with the stage of Canadian economic development. A competitive force is identified by application of demand and monopoly theory. External market conditions are considered critical for effective competition. These and variations in protection from exchange rates and tariffs are assessed by analysis of price, output, investment, and profits of the industry. Competitive forces internal to the industry are also assessed against standards for effective competition.

KENNETH G. ELZINGA, Ph.D. Michigan State 1967. The effectiveness of relief decrees in antimerger cases.

The problem in this thesis is to evaluate the effectiveness of relief decrees obtained in antimerger cases and identify the obstacles to the formulation of effective relief. Criteria for evaluating relief decrees are developed against which relief orders in a sample of 39 antimerger cases are judged. Relief under the antimerger law is found to be less than satisfactory. The reasons for this are outlined and public policy measures are recommended.

EDWARD W. ERICKSON, Ph.D. Vanderbilt 1968. Economic incentives, industrial structure and the supply of crude oil discoveries in the U.S., 1946-1958/59.

DONALD FARNES, Ph.D. Washington 1968. Identification of footloose industries.

GARY FETHEKE, Ph.D. Iowa 1968. Price, production, and inventory in an imperfect and uncertain market: the United States sulfur industry.

LUIS H. FORTIN, Ph.D. Columbia 1968. Financing capital investment in the airline industry.

The analysis presents the various factors that will influence the ability of the 12 major U.S. airlines to meet the financial requirements for new equipment including the large advanced subsonic jet aircraft as well as the supersonic transports in the decade 1966-1975. The historical demand for air transportation is analyzed, and traffic projections are made for the period under study. Capacity needed to meet this demand is estimated and the amount of uses and sources of funds for the period is calculated.

PHILIP E. FRANKLIN, Ph.D. American 1968. The economic impact of flag discrimination in ocean transportation.

This study measures the economic effect of flag discrimination, the most commonly used policy for maritime promotion since the end of World War II. Employed by more than two-thirds of the 90 nations having merchant marines, it is a form of monopoly which controls the routing to national flag vessels of one-eighth of cargo tonnage, representing one-fifth of the value of oceanborne international trade, thus raising world shipping costs by \$500,000,000 annually.

AARON J. GELLMAN, Ph.D. Mass. Inst. Technology 1968. The effect of regulation on aircraft choice.

This study is concerned with the impact of economic regulation upon the critical airline managerial decision of aircraft choice from 1945-1957 in the domestic trunk airline industry of the United States. With the CAB severely constraining airline competition in certain areas, including rates, it is clear that certain aircraft choices were made largely to permit one carrier to differentiate its "product" from competitors in a market characterized by price identity. The employment of new types of aircraft in the several city-pair markets examined supports the hypothesis that the CAB frequently caused management's investment decisions and innovative drives to be distorted.

THOMAS K. GLENNAN, JR., Ph.D. Stanford 1968. New product development: some observations based on military airframe experience.

This study treats the development of a new airframe as a productive process and examines the relationship between the output (as characterized by performance characteristics), inputs (the costs of engineering, tooling, and production support) and process characteristics (speed of development and degree of technological advance sought). Regression analysis is used to examine the relationship of cost elements to product and process characteristics. Development costs seem primarily determined by the absolute size and complexity of the aircraft. There was no significant relationship between development costs and a crude measure of technological advancement embodied in the airframe.

ANDREW J. GOLD, Ph.D. Northwestern 1967. Commission decision making in intermode transportation rate cases.

SEYMOUR E. GOLDSTONE, Ph.D. Ohio State 1967. Short-run instability in the industrial contract research industry.

RICHARD A. GOODMAN, D.B.A. Washington (St. Louis) 1968. Organizational effects upon manpower utilization in research and development.

This study investigated the effect of the project management and the matrix management forms of organization on the stability and flexibility of manpower in research and development. The project form was shown to have qualities generally useful for short-run research and development problems. That matrix form was shown to be more flexible, to have a lower rate of voluntary terminations, and to have qualities generally useful for the solution of long-run research and development problems.

ALBERTO GUADAGNI, Ph.D. California (Berkeley) 1967. Planning the electricity supply for Greater Buenos Aires.

TAYE GULILAT, Ph.D. California (Berkeley) 1967. Protection and infant industry promotion: a case study of the Indian iron and steel industry from 1924 to 1938.

DAVID E. HAHN, Ph.D. Cornell 1968. A description of the frozen dessert manufacturing industry in New York and comparison of three alternative distribution systems.

EDWARD J. HEIDEN, Ph.D. Washington (St. Louis) 1967. Some economic problems of international space telecommunications.

JOHN M. HEINEKE, Ph.D. Iowa 1968. Price, production and sales equilibrium in an imperfect and uncertain market: the lead industry.

WILLIAM D. HENLEY, Ph.D. Alabama 1967. An analysis of pricing legislation with particular emphasis on state unfair cigarette sales acts.

CHRISTOPHER HIGGINS, Ph.D. Pennsylvania 1968. An econometric description of the U.S. steel industry.

The study consists of an econometric investigation of the demand, investment, and production relationships for the U.S. steel industry as an aggregate, in the post-World War II period. Detailed technological information underlies the specification of annual production and input relationships whereas market structure is paramount in quarterly demand for steel. The primary emphasis is on structure but a suitable basis for forecasting is also provided by explicit links with variables endogenous to macroeconomic models.

GERALD F. HIGGINS, Ph.D. Iowa (Ames) 1967. Variability of employment between defense and non-defense industries.

JEFFREY JARRETT, Ph.D. New York 1967. The profit performance of electric and gas utilities as opposed to non-regulated industries: an analysis.

GEORGE JENSEN, Ph.D. Washington 1968. The regional economic impact of defense spending: the Utah case.

DAVID E. JOHNSON, Ph.D. California (Berkeley) 1968. The Pacific Coast petroleum industry: market structure and competition, 1936-1958.

JAMES M. L. KARNS, Ph.D. Oklahoma 1968. The impact of defense spending in El Paso County, Colorado, 1941-1965.

This econometric study employs quarterly time series data to analyze the impact upon El Paso County, Colorado, by three military installations: The United States Air Force Academy, Ent Air Force Base, and Fort Carson, Colorado. Quarterly estimates of private nonagricultural employment are regressed upon military strength and defense civil service employment to obtain differential employment multiplier ratios. Military payrolls and other defense expenditures for the period since 1954 corroborate these differential estimates.

NABIL T. KHOURY, Ph.D. Indiana 1968. The impact of the electric car on the oil industry.

The mass adoption of the electric car will affect primarily the distribution pattern of the energy requirements among the energy sources. The study is limited to a 15 year period ending in 1982 and is structured around three projections concerning the annual sales of new electric cars; high, medium, and low range projections. The high and medium range projections are fitted to a Comportz curve of the form  $Y = ka^{bx}$ . The low range projection is fitted to a linear trend. The annual sales of new electric cars are then cumulated, and the cumulative decline in motor fuel demand estimated for each projection. In the absence of

an offsetting increase in the demand for one or more of the other petroleum products, the crude oil industry will have to adjust its operations. The analysis focuses on a price and a quantity adjustment. Several alternatives are evaluated with regard to their implication for efficiency in crude oil extraction.

SUNG-WOO KIM, Ph.D. California (Berkeley) 1967. Capital appropriation and investment behavior of U.S. manufacturing industry, 1947-1964.

RANDALL R. KINCAID, JR., Ph.D. Duke 1967. Economics of cigar-wrapper tobacco.

FREDERICK R. KLEIN, Ph.D. Columbia 1968. When smoke blackened sail—on the timing of the conversion of merchant fleets from sail to steam.

C. JOHN KURIEN, Ph.D. Vanderbilt 1967. Technical change in United States manufacturing industries: 1947-1964.

ROBERT D. LAMSON, Ph.D. Washington 1967. Motion picture exhibition: an economic analysis of quality, quantity, and productivity.

ROBERT LARNER, Ph.D. Wisconsin 1968. Separation of ownership and control and its implications for the behavior of the firm.

The dissertation measures the extent of the separation of ownership and control among the 500 largest nonfinancial corporations of 1963 and investigates the behavioral consequences of this separation. One hundred sixty-seven of the "200 largest" and 377 of the "500 largest" were found to be management controlled, but there were no major differences in the level and stability of profit rates that might be attributed to management control. Executive compensation was more closely correlated with profits than with size or growth.

BILLY J. LINDER, D.B.A. Oregon 1968. Antitrust and business decision making: a study of the Von's Decision.

Current U. S. antitrust policy in regard to mergers was analyzed, with special emphasis on the 1966 Von's Decision. The study traces the history of competition, mergers, and antitrust policies, and examines legal precedents and the Von's case. It concludes that the Von's Decision significantly broadens application of merger law to include the activities of small business, ultimately resulting in restrictions on opportunities to expand by way of horizontal merger.

W. BLAIR LITTLE, D.B.A. Harvard 1968. New product information processing: a descriptive study of product innovation in the machine tool industry.

GENE LOERKE, Ph.D. Oklahoma 1968. The public policy, public finance, and economic aspects of municipal ownership of liquor stores in Minnesota, 1964-1966.

In comparing municipal and private liquor operations in Minnesota, it was found that municipal on-sale stores generally sold for the same or lower prices, employed fewer economic resources, violated liquor laws less often, paid their employees more, and offered about the same service as private on-sale dispensaries. It was also found that in liquor dispensaries, economies of scale were almost entirely absent and diseconomies of scale were present at relatively low sales levels.

RICHARD J. LORETTE, D.B.A. Harvard 1967. The relationship between pressures on the system program director and the growth of weapon system cost estimates.

PATRICK MANN, Ph.D. Indiana 1967. An inquiry into the problems of municipal water pricing.

This thesis is an economic analysis of urban water pricing and regulatory practices. The analysis is primarily of pricing practices in Indiana and a specific example of these practices, the pricing of Bloomington water. Special attention is given to the problems of determining the cost functions of water utilities. There appear to be two major obstacles to a more rational pricing of water. First, the regulatory rate-making mechanism for water is deficient. The use of past costs and consumption, the influence of the bond market, and statutory constraints tend to produce excessive rates. Second, there is a crucial need for more analysis and information on the cost functions of urban water supply. There appears to be limited knowledge on costs of supplying water service. There is limited information for the com-

putation of marginal costs of supply. A rate schedule is proposed that incorporates both marginal costs and estimated future costs.

DAVID R. MILLER, Ph.D. Northwestern 1967. Cost functions in urban bus transportation.

This dissertation studies the long-run cost function for urban bus transportation and some of the underlying production function relationships. Multiple regression techniques are applied to a sample of 33 medium-size cities. Cost of bus service is found to depend on certain characteristics of the city as well as on factor costs and the technological production function.

WILLIAM E. MORAN, Ph.D. Michigan 1967. A comparative study of intra-organizational control and communication.

LEO J. NAVIN, Ph.D. Michigan State 1968. An analysis of the demand for liquor in Michigan.

Through the use of time series data, price and income elasticities are identified for quantity and dollar sales of liquor. These elasticities are formed on three planes: for composite, distilled spirits, and component functions. These results are employed in state monopoly profit and excise revenue models which are developed.

ROBERT J. OSTER, Ph.D. California (Berkeley) 1967. The cost of capital and investment behavior: a study of the opportunity cost of investment, its determinants and its determination of business investment behavior.

EDWIN P. PATTON, Ph.D. North Carolina 1968. The determinants and implications of motor carrier growth in California.

Study evaluates California Public Utilities Commission policy toward the State's common motor carrier industry by determining Commission attitude toward and the (dis)advantages of carrier expansion. Findings reveal that carriers can expand at whatever rate they choose but that relatively small carriers maintain financially sounder enterprises and generate greater output per dollar of input than larger competitors. Study recommends a Commission price policy based on low-cost firms with greater attention to cost (dis)advantages of carrier size.

JOHN V. PETROF, Ph.D. Florida 1967. A study of the Florida natural sponge industry with special emphasis on its marketing problems.

The American natural sponge industry has been experiencing a decline since the 1930s. An analysis of the industry indicated that this has been caused by production difficulties, competition from substitute products, and the inability of the industry to adjust to changing consumer demands. Spongers have been trying to reverse the situation through increased production and legislation. This study indicates that aiming the product to a new market may be the only solution to the problem.

ROBERT J. PIERSOL, D.B.A. Harvard 1967. The accuracy of methods of estimating geographic markets for industrial products.

WILLIAM E. PINNEY, Ph.D. Florida 1967. An analysis of risk in the aerospace industry.

MARION POSEY, Ph.D. Arkansas 1968. A study of public utility expansion.

ROSS PRESTON, Ph.D. Pennsylvania 1967. An industry study of constant elasticity of substitution production functions with special emphasis on capacity and capacity utilization.

RICHARD L. SANDOR, Ph.D. Minnesota 1967. Size of firm, economics of scale in research and development and the use of patented inventions.

The dissertation examined if lower "use-rates" of large firms constituted evidence of diseconomies of scale in R&D. The study postulated and tested the hypothesis that large firms have patents with lower probabilities of use because they (a) undertake research which a priori is riskier, (b) conduct more parallel R&D, (c) specialize less, and (d) have diminishing output from non-R&D employees. The findings tentatively indicate the validity of (b) and (d).

GEORGE H. K. SCHENCK, Ph.D. Pennsylvania State 1967. Economic importance of the coal industry to Pennsylvania.

This regional analysis is based on published state and national data and information collected in field surveys of coal companies and related activities in Pennsylvania counties. Producing areas are cross-classified in several ways with special attention given to "coal-

focused" counties where mining averages 15 per cent of payrolls. Inferences based on input-output analysis indicates that the local multiplier for coal sales exceeds 2.2. Relative economic contribution of mining was found to vary widely within "primary" coal counties.

GUNTER SCHRAMM, Ph.D. Michigan 1967. The role of low-cost power in economic development. A case study: Alaska.

CLARENCE A. SPENCER, JR., Ph.D. Alabama 1967. The regulation of fire insurance in Alabama with special emphasis upon rate regulation.

DALE B. TRUETT, Ph.D. Texas 1967. Sulfur and the development of a chemical fertilizer industry in Mexico.

HIROKI TSURUMI, Ph.D. Pennsylvania 1967. An econometric study of oligopolistic competition among American automobile firms, 1947-1965.

A system of 30 simultaneous equations was built and estimated by two-stage least squares for each of the five companies: General Motors, Ford, Chrysler, American Motors and Studebaker. Each model explains various activities including demand for cars, investment price, wage and profits by emphasizing interdependence of price-output decisions of the competitors. The estimated result and sample simulation by solving five company models simultaneously support the present position of the "big three."

DAVID I. VERWAY, Ph.D. Michigan State 1968. An analysis of the determinants of routine personal services employment.

This research tests the hypothesis that poor labor market conditions, in terms of unemployment and other indicators of the labor market situation, are positively associated with employment in routine personal services occupations. In the demand functions, the relevance of factors such as the opportunity cost of home production and the distribution of income are tested. Basic data were adapted from the 1950 and 1960 Population Censuses, with states as units of observation.

ROBERT F. VIZZA, Ph.D. New York 1967. A study of the education and formal management training of chief sales executives of large industrial goods firms.

RONALD VOGEL, Ph.D. Wisconsin 1967. Wisconsin highway acceleration: an economic model for its evaluation.

DARWIN WASSINK, Ph.D. Stanford 1968. Commercial policy and development: a study of the automobile industry in developing countries.

The automobile industry is studied to determine the effectiveness of present policies in promoting economic development. The technology of the industry and economies of scale are considered as indications of expected costs of domestic production. The commercial policies of selected developing countries are analyzed with respect to effective protection to the industry, efficiency characteristics that result, and expected dynamic benefits to the country. In conclusion suggestions are presented for improved policies for developing countries.

ROBERT E. WILLARD, Ph.D. Arizona 1968. The quantitative significance of the gaming industry in the Greater Las Vegas area.

By the use of an intersectoral flows table for 1966 it was possible to estimate the short- and long-run impacts of gambling on Las Vegas. The short-run employment multiplier (1.57) indicates that for each person employed in gaming 57 of a person must be employed in consumption goods industries. The long-run multiplier (2.31) shows that each person employed in gaming causes 1.31 persons to be employed in all other sectors (excluding export industries other than gaming).

HENRY F. WILLIAMS, Ph.D. Indiana 1968. Economic changes in the motion picture industry as affected by television and other factors.

This study of the motion picture industry has helped to test and clarify several economic concepts and theories. It suggests that the actual market structure and the orientation of factors and firms can be a useful criterion for the classification of products and industries. Differences in the operation of consumer demand may further differentiate one industry from another. The importance of non-price competition in the form of product differentiation is shown in the competitive struggle between motion pictures and television. A high

correlation between the decline of motion picture attendance and the increased ownership of television sets in different regions of the nation is established.

RALPH A. WINTER, Ph.D. Ohio State 1967. Regulation of the consumer finance industry: a reappraisal of its economic impact.

FRANCIS W. WOLEK, D.B.A. Harvard 1967. The structure of work and the flow of information in science and engineering.

### Land Economics; Agricultural Economics; Economic Geography; Housing

SALEH AFIFF, Ph.D. Oregon State 1968. Food supply and economic development in Indonesia, problems and prospects.

RAMESH C. AGRAWAL, Ph.D. Iowa (Ames) 1967. Applications of operations research techniques in agriculture.

DONALD E. ANDERSON, Ph.D. Minnesota 1968. The impact of the Commodity Credit Corporation on the structure of grain markets in the North Central region.

This study presents an analysis of the operation of the Commodity Credit Corporation and an assessment of the impact of CCC policy on the organization and operation of grain markets. The objectives of the study were: (1) develop an understanding of the legislative history of CCC operating policies; (2) determine the impact of CCC acquisition, storage, and disposal policies on the organization and operational efficiency of firms in the grain industry; (3) determine the influence of CCC policies on firm behavior patterns and pricing efficiency of the grain industry.

GLEN W. ATKINSON, Ph.D. Oklahoma 1968. The geographic origin of overnight guests at the Oklahoma State Lodges.

The State of Oklahoma operates seven lodges in its park system. A major purpose of the lodges is to attract out-of-state visitors. However, an analysis of the 50,000 lodge guest registration cards for 1966 revealed that 60 per cent of the guests were from Oklahoma, and 25 per cent came from Texas. Only 4 per cent came from beyond the seven states surrounding Oklahoma. An analysis of visitor-days showed the average length of stay was 1½ nights. The geographic and season distributions of expenditures for rooms were similar to the distribution of guests and visitor-days.

JOHN D. BENNETT, Ph.D. Syracuse 1967. Economics and the folklore of forestry.

ARLO BIERE, Ph.D. California (Berkeley) 1968. River basin management with particular reference to the Salinas Basin.

ROBERT L. BISH, Ph.D. Indiana 1968. The distribution of housing taxes and subsidies and effects on housing consumption of low-income families.

The dissertation includes a study of the distribution of benefits for housing occupants of the major government subsidy programs (public housing and below market interest rate loans for non-profit rental housing). The subsidies are then related to the special treatment housing receives under the income and property taxes to project the effects government policies have on the housing consumption of low-income families. The study contains implications for housing policy, tax policy, and intergovernmental fiscal relations.

HAROLD F. BJARNASON, Ph.D. Wisconsin 1967. An economic analysis of 1980 international trade—feed grains.

LEROY L. BLAKESLEE, Ph.D. Iowa (Ames) 1967. An analysis of projected world food production and demand in 1970, 1985, and 2000.

KALMAN BLUM, Ph.D. California (Berkeley) 1968. On explaining productivity change in United States agriculture.

HOWARD J. BROWN, Ph.D. Indiana 1967. Employment shift analysis of regional economic growth: a critique.

The dissertation casts doubt on the usefulness of the employment shift technique for descriptive analysis and as a forecasting model. Three forms of employment shift models are compared to simple extrapolations for both level and percentage change of manufacturing

employment. None of the forms predicts as well as the simple extrapolations. Further, the competitive component is not stable enough to be useful for classifying regional industries over time. Finally, multiple regression analysis shows that only a very small percent (12% at best) of the variation in the competitive component can be accounted for by the variables that have been used to explain the values of the component.

RICHARD W. BRUCE, Ph.D. Washington State 1968. Intraregional competition in lumber markets of the eleven Western States.

C. CURTIS CABLE, JR., Ph.D. Minnesota 1968. Economic models for a cotton ginning-warehousing complex.

The objectives of this study were to develop economic models of centrally located cotton ginning-warehousing complexes, and compare the costs of performing marketing services at model plants to the costs of services currently provided by conventional gins and warehouses. Costs associated with the models were lower by \$1.12 to \$7.80 per bale, due to economies of scale in ginning, elimination of conventional bale hauling services, and less handling at successive marketing stages.

ROGER K. CHISHOLM, Ph.D. Chicago 1967. Rate of return to investment in farmland.

Rental payments to landlords in three midwestern states were used to measure the income stream generated by farmland. It was then shown that for the 1945-64 period, the relationship between income generated by farmland and the price of the farmland closely matched the income stream-price relationship of alternative assets using common stocks as representative of other assets.

HERSCHEL D. CLAXTON, Ph.D. California (Berkeley) 1968. A dynamic programming decision model and computer simulation of the cedar pencil slat drying process.

This dissertation presents a dynamic process control model. Computer simulation models are developed for a moisture transfer process and for dry kiln operating characteristics. Nonlinear regression techniques are used for estimating response surfaces and parameter values for the diffusion simulator. The two simulators are used by a dynamic program to obtain optimum schedules. These schedules can either minimize the cost of producing a specified output or maximize the imputed net value when there is no restriction on output.

NORRIS C. CLEMENT, Ph.D. Colorado 1968. The economic viability of the Mexican Ejido: a case study of three Ejidos in Jalisco.

EDGAR D. COOK, JR., Ph.D. Florida 1967. Changing land use patterns in campus perimeter areas.

Traditional urban studies have concentrated on understanding the process of expanding urban growth. Therefore, there is a lack of understanding about land re-use problems and procedures in established, highly developed neighborhoods. Recent economic and social pressures have accelerated the normally slow process of land use change in the campus perimeter neighborhood, making it an ideal pilot model neighborhood in which to develop an orderly approach to a deeper understanding of land re-use problems.

GAIL L. CRAMER, Ph.D. Oregon State 1968. An economic analysis of the merger component in the growth of agricultural cooperatives.

The purpose of this study was to determine the ex ante objectives of mergers among agricultural cooperatives, to determine the extent to which these objectives were achieved via merger, and to identify factors that were instrumental in the success or lack of success in equating ex ante objectives and ex post merger results. Also, the impact of mergers on past and future growth of agricultural cooperatives was examined.

THOMAS D. CROCKER, Ph.D. Missouri (Columbia) 1967. Some economics of air pollution control.

J. H. DACHER, Ph.D. McGill 1968. Effect of the national oil policy on the Ontario petroleum refining industry.

The work traces the development of the petroleum industry in Ontario and the impact on that industry of rising crude oil production in Western Canada in the 1950's. This is followed by an analysis of the circumstances that gave rise at the time to a Canadian National Oil Policy. A linear model of the Ontario petroleum refining industry is then advanced and validated against most recent industry statistics. Three extreme interpretations



of the National Oil Policy (including non-compliance as a datum point) are then considered, each of which is treated as an added set of constraints in the model. Optimal solutions for each of these submodels are derived from which industry operations under each of these interpretations are forecast and analyzed as to their cost, their effect on demand for domestic crude oil, on type of new refinery plant additions and on the structure of production.

JOHN R. DOUGLAS, Ph.D. Iowa (Ames) 1967. Uses of linear programming techniques in the fertilizer industry.

PAUL DOWNING, Ph.D. Wisconsin 1967. The economics of urban sewage utilities.

This dissertation develops the cost characteristics of the urban sewage utility and then applies this data to several issues of relevance to local decision-makers. Some of the issues discussed are: the trade-off between garbage grinders and garbage collection, the peak load problem, the optimal size of a sewage utility, the effect of water quality standards on the utility, and the financing of urban sewage disposal.

JACK D. EDWARDS, Ph.D. Kansas State 1968. Economic impacts of roads and highway improvement on farm real estate values in Kansas.

Roads and highway improvements reduce costs of transportation. Land owners often are among the beneficiaries. This dissertation estimated the effects of various classes of roads on farm real estate values in four sample areas of Kansas. Sale prices and data describing tracts including road characteristics were related through multiple regression analysis. Improved roads had more effect on land prices in eastern than western Kansas.

RICHARD D. ERB, Ph.D. Stanford 1968. Post-war developments in metropolitan residential density.

This cross-section empirical study examines postwar residential density developments in a sample of forty metropolitan areas. The change in residential density of an urban area, or more simply marginal density, is measured by the single dwelling proportion of total urban construction. The key explanatory variables include family income and demographic variables. Contrary to previous hypotheses, the relation between income and marginal residential density turned out to be non-monotonic; increasing family income does not necessarily imply a higher proportion of single dwelling construction. Variables such as family size, employment, and total population also contributed significantly to the explanation of difference in marginal density among urban areas.

BRUCE J. FLOREA, Ph.D. Missouri (Columbia) 1967. Scale and utilization economies of feeding cattle under three feeding systems: a feasibility study.

JAMES GARRETT, Ph.D. Washington State 1967. Economies of scale of livestock auctions in the Pacific Northwest.

CHARLES B. GARRISON, Ph.D. Kentucky 1967. Economic impact of new industry on small towns.

This study investigates the impact of new industry on the local economy of five small Kentucky towns of 1,000 to 5,000 population. The method used is community multiplier analysis, with economic base theory providing a conceptual framework and a means of defining the local economic structure. The multiplier effect on non-basic employment is small, and the income effect, while considerably larger, is greater for proprietors' and property income than for wages and salaries.

C. KERRY GEE, Ph.D. Oregon State 1968. An analysis of factors which contribute to differences between actual and programmed optimum organization on individual farm units.

This study investigated components of maximum profit linear programming models and characteristics of farm operators which create differences between actual farm organization and that obtained through the programming technique. Three models were constructed for each of twenty farms. The first model dealt with year-to-year choices among alternative levels of participation in government wheat and feed grain programs. Actual and programmed choices were compared for the years from 1963 through 1966. The second and third models calculated farm organization on the assumption that land, family labor, and in some cases operating capital were fixed resources. The principal model required a maximum profit objective function while the other considered the least cost method of obtaining the current level of farm income. These two models provided a basis for evaluating

factors which caused differences between the maximum profit and actual farm organization on the twenty farms within this longer length of run situation.

JON H. GOLDSTEIN, Ph.D. Minnesota 1967. An economic analysis of the wetlands problem in Minnesota.

Wetlands throughout the midwest have two alternative uses: (1) in their natural state they constitute a major source of breeding and nesting habitat for waterfowl along the Mississippi flyway; (2) they can be converted into high fertility, arable land by drainage. Partly due to government subsidies extensive reclamation has been occurring. This thesis investigates whether in the absence of such subsidies a private mechanism exists to effect an optimal allocation of wetlands between the agricultural and wildlife sectors.

HENRY A. GOTTLIEBER, Ph.D. Arkansas 1968. Planning for smaller community regional airports: a Northwest Arkansas study.

JOHANNES A. GROENEWALD, Ph.D. Purdue 1967. Selection of optimum processes and machinery combinations in crop production in corn belt farms.

Survey data were used to determine the effect of seeding rates, fertilization and planting time on the returns from three hybrids. A systems simulation model was employed to maximize system value, i.e., crop value minus fertilizer, seed and system costs.

JOHN W. HAGEN, Ph.D. Washington State 1968. The relationship of the development of the Washington apple industry to changes in food retailing.

JOHN HEINBERG, Ph.D. Wisconsin 1967. Public policy toward residential rehabilitation: an economic analysis.

This study investigates the role of public policy in encouraging rehabilitation and maintenance of residential real estate. After examining general policy constraints and economic factors associated with housing inadequacy, emphasis is put on description and evaluation of U.S. federal housing rehabilitation policy from 1954 through 1966. Strong reliance is placed on data from a June 1966 nationwide questionnaire survey of 49 local urban renewal agencies. It is concluded that rehabilitation deserves greater policy emphasis, despite significant unresolved problems.

THOR A. HERTSGAARD, Ph.D. Minnesota 1967. Comparative advantage analysis of meat and poultry production in the United States.

A linear programming framework was employed to estimate comparative advantage relationships among 15 producing regions for the production and transportation of beef, pork, turkey, broilers, and eggs to 11 consuming regions. A separate analysis was made for each of the years 1954, 1957 and 1960-66. Costs of production in each of the regions were based on the costs of feed ingredients in the respective years.

NORMAN L. HICKS, Ph.D. Maryland 1967. The economics of urban transportation.

ROYCE A. HINTON, Ph.D. Minnesota 1968. The economics of labor and choice of swine housing.

The study determined the parameters of labor information needed for choosing the optimum housing system for swine. Task-function labor records from large-scale hog farmers were analyzed. Significant class differences in the labor requirements were found between the three years of swine housing—enclosed confinement, conventional confinement and portable—in addition to the differences associated with size of enterprise, time in phase and worker pressure.

DONALD J. HUNTER, Ph.D. Iowa (Ames) 1967. Livestock supply functions, a short-run static analysis.

JOHN D. HYSLOP, Ph.D. Minnesota 1967. An economic analysis of price-quality relationships in spring wheat.

The thesis is in two parts. The first part examines the relevance of the official standards for federal grades of spring wheat and their implications for pricing efficiency. The second part examines the demand for spring wheat protein. Protein premiums were found to be highly flexible with respect to the average protein content of the hard wheat crops. This has implications for varietal development research and for the effectiveness of the Minneapolis wheat for hedging high protein wheat.

CHRISTOPHER O. ILORI, Ph.D. Stanford 1968. Economic study of production and distribution of staple foodcrops in Western Nigeria.

This study is an integrated analysis of the production, consumption, and marketing of the major staple foodcrops in Western Nigeria. Its objectives were to discover the proportion of peasant food production available for sale in the markets, analyze the changing dietary patterns in rural and urban areas, describe the traditions and practices of the markets, and determine costs and profit margins.

MILTON A. JACOBSON, Ph.D. Purdue 1968. Basic competitive price relationships among major food fats and oils.

The objectives of this study were: (1) to describe the nature of the production and utilization of food fats and oils in order to understand the process of price determination in the fats and oils economy; (2) to estimate the price flexibilities and cross flexibilities for the major food fats and oils; and (3) to determine the nature of price determination for a minor oil such as corn oil.

FRANK I. JEWETT, Ph.D. Claremont 1968. A quarterly econometric model of Humboldt County, California, 1950-1964.

The county's isolated location and heavy dependence upon a single export industry, forest products, make it possible to treat it as an economic region. A five-equation linear model, explaining taxable transactions and two categories of insured employment and earnings within the county, was developed and estimated. Impact multipliers obtained from the model were used to investigate several changes in the forest products industry including the impact of the proposed Redwoods National Park.

ROBERT H. JONES, Ph.D. Harvard 1968. Efficient patterns of land use, with reference to costs and incomes in Latin America, particularly in Venezuela.

SAMUEL R. JONES, Ph.D. Arkansas 1968. An evaluation of rural area industrial development organizations.

MARVIN G. JULIUS, Ph.D. Iowa (Ames) 1968. Approximation of the export employment structure of functional economic areas.

ROY KARAOGLAN, Ph.D. Columbia 1967. The sugar industry in Lebanon: a case study in agricultural protection.

WILLIS G. KEARL, Ph.D. California (Berkeley) 1968. Comparative livestock systems and technologies on ranches in the northern plains region of the United States.

This study compared several livestock systems under Northern Great Plains conditions. Three advanced technologies were also studied and a simple form of simulation was used. Averaged over a time period, the cow-yearling systems appeared to be slightly more profitable than the cow-calf systems of operation, and the purchased stocker systems were considerably more profitable than either, assuming that the supply of stockers could be procured from a nearby local area.

MAXWELL I. KLAYMAN, Ph.D. Harvard 1968. The Moshav in Israel: a case study of institution building for agricultural development.

This study analyzes the success of the Moshav in Israel and the possibilities of its adaptation to other countries. Where the aims of national policy are the development of agriculture based on intensive family-type farms, the development of peasants into commercial farmers in a short time span, and the resettlement of the new areas requiring heavy infrastructure investments, the application of Moshav principles could be pertinent.

CURTIS H. KNIGHT, Ph.D. Indiana 1968. The economics of the Soviet food industry.

An economic study was conducted of the Soviet food industry from 1928-64. Factors analyzed included: changes in the consumers' diet and the demands this placed on the food industry in terms of capacity requirements, technological and structural change; individual branch contributions toward modernization and food industry growth; distribution, transportation, and storage capacities; and output growth in relation to agricultural supply, and capital and labor inputs combined.

HENRY A. KNOPP, Ph.D. Cornell 1967. Changes in wheat production in the United States, 1607-1960.

LARRY N. LANGEMEIER, Ph.D. Missouri (Columbia) 1968. A spatial equilibrium analysis to determine the optimum location of cattle feeding in the United States under various constraint specifications.

KIE WOOK LEE, Ph.D. Vanderbilt 1968. Efficiency of resource allocation in traditional agriculture: a case study of South Korea.

AN-YHI LIN, Ph.D. Iowa (Ames) 1967. Factor demand in United States agriculture: econometric simulation.

JAMES H. LOVERING, Ph.D. Cornell 1967. Agricultural development possibilities, South-eastern Renfrew County, Ontario.

RICHARD M. A. LOYNS, Ph.D. California (Berkeley) 1968. An economic analysis of the marketing order for California almonds.

This study used time series data for the period 1950-65 to analyze the demand characteristics of California almonds. Estimates of demand parameters were derived by ordinary least squares and principal components in two-stage least squares regression. Measures of the revenue impact of market regulation were obtained and quadratic programming was used to derive short-run revenue maximizing product distribution. In addition, implications of parity pricing and the future profitability of almond production in California were analyzed.

RICHARD E. LUND, Ph.D. Iowa (Ames) 1967. Factors affecting consumer demand for meat, Webster County, Iowa.

YU-KANG MAO, Ph.D. Cornell 1968. A case study of economic effects of land consolidation on farms in Chichow Area, Changhua Hsien, Taiwan, 1962-1963.

LEO V. MAYER, Ph.D. Iowa (Ames) 1967. An analysis of future resource supplies, resource utilization, domestic and export demand, and structural change in the agricultural economy to 1980.

EDWARD F. McDONOUGH, Ph.D. Massachusetts 1968. A cost-benefit analysis of a Hartford, Connecticut, urban renewal project.

The economic and social justifications for a renewal project are reviewed by the use of a cost-benefit technique and are contrasted with the conclusions reached by the local planning agencies. In an *ex ante* application, this technique can materially alter the assessment of the desirability of projects before the decision is made to proceed with the project. The use of a discount rate and the impact of project delays raise serious doubts as to the feasibility of the project.

KENTON R. MILLER, Ph.D. Syracuse 1967. Some economic problems of outdoor recreation planning in Puerto Rico.

MARLEN F. MILLER, Ph.D. Minnesota 1967. A measurement of factor productivities in Minnesota agriculture.

The parameters of an average production function for Minnesota's agricultural industry were estimated via least squares. Refinements in the empirical work included: a weather index; an education index for farm operators; a weighted regression scheme; and an adjacent index for land. The analysis indicated that in 1964 all resource categories in agriculture, except the labor of farm operators and unpaid family workers, were earning returns equivalent to their opportunity costs.

THOMAS A. MILLER, Ph.D. Iowa (Ames) 1967. Aggregation error in representative farm linear programming supply estimates.

MAX MOSZER, Ph.D. Pennsylvania 1966. American wheat farmer and agricultural programs 1939-1964, a quantitative analysis.

This is a study of the laws which were passed by the Congress and administered by the Department of Agriculture whose aims were to increase the income of wheat farmers and to reduce the accumulation of surplus wheat through wheat acreage reduction. While direct payments to farmers increase their income, price supports, because of their effects on the "free" market price of wheat, benefit even those farmers not cooperating with the acreage allotments. Thus the evaluation of the program must be in terms of the accomplished surplus and/or acreage reduction and of the profitability of the alternatives offered the

wheat farmer. The provisions of various programs are set forth and explained. Analysis is carried out by means of break-even criteria. This study indicates that it is possible to quantify the necessary policy variables for a successful acreage reduction program within a quasi-free market framework.

LESTER H. MYERS, Ph.D. Purdue 1968. Economic analysis of the monthly structure of the hog-pork sector in the United States.

The primary objective of this study was to identify and quantify the monthly structure of the hog-pork economy in the United States. The structural model consists of eight behavioral equations describing the monthly supply of hogs and cattle for slaughter; the monthly supply of pork for consumption; the retail demands for pork, beef, and broilers; the farm-to-retail margins for pork and beef. Two-stage least-squares techniques were used to estimate the structural parameters.

PALANISAMY NAGARAJAN, Ph.D. Kansas State 1968. An analysis of forces affecting the conditions of entry into the fresh product industry by Southwest Kansas Growers.

The structural characteristics of the Wichita and Kansas City wholesale produce markets and procurement practices and methods of the produce wholesaling firms indicate that there are informational, organizational and distributional barriers to enter into the fresh produce industry by the potential producers of southwest Kansas. This requires producer organization and marketing tactics substantially different from that more nearly approaching the historic "open market."

DAVID M. NELSON, Ph.D. Kansas State 1968. Value of water for irrigation in the Kansas River Valley.

The demand for water for all purposes is increasing rapidly in the Kansas River Valley. As this continues, more precision will be needed in public and private (market) allocation of water. Economic returns in various uses provide one basis of allocation. This dissertation estimates the value of water for irrigation. Average annual precipitation in the Valley varies from 31 to 36 inches; consequently, returns from irrigation are less than in lower-precipitation areas.

EDGAR O. OLSEN, Ph.D. Rice 1968. A welfare economic evaluation of public housing.

A Paretian welfare economics model is formulated in which transfers in cash and in kind are necessary for efficient resource allocation. This model enables us to use consumer's surplus analysis to choose between alternative means of achieving specific redistributive wants. It is estimated that public production of housing service has resulted in a waste of 46 per cent and the unequal pattern of subsidies among equally eligible families is a waste of 11 per cent of public expenditures.

SEBASTIAN J. RACITI, Ph.D. Fordham 1968. An analysis of the decline of the Jersey City economy and an evaluation of proposals for its resurgence.

Historically, Jersey City prospered as a marine-lighterage terminal for freight passing through the Port of New York. As this relationship started to change, the city's economic and fiscal base eroded. Large portions of its once active waterfront became idle or were abandoned. More economic use of this land located at the core of the New York Metropolitan Region holds the key to a revitalization of the city's economy. Proposals are evaluated and recommendations are made to this end.

LUCCO G. RECA, Ph.D. Chicago 1967. The price and production duality within Argentine agriculture, 1923-1965.

A historical analysis of the evolution of agriculture in Argentina in the last four decades, with particular emphasis on explaining the coexistence of dynamic and stagnant sectors within agriculture.

NALLAPU N. REDDY, Ph.D. Pennsylvania State 1967. An economic analysis of the impacts of the United States stockpile policy on the international copper industry.

With the passage of the Strategic and Critical Materials Stockpiling Act in 1946, the maintenance of stocks of strategic and critical materials as an essential element of national security became an accepted national raw materials policy. Under this Act and the subsequent legislative authority, the government had acquired almost \$9 billion worth of strategic and critical materials. Purchases of this magnitude are bound to spread their effects on the

international raw materials markets. The purpose of this study has been to analyze the impacts of the stockpile policy on the international copper industry between 1948-1966.

URI REGEV, Ph.D. California (Berkeley) 1967. Adaptive investment strategy with particular reference to river basin development.

This study develops an investment model recognizing explicitly two basic features of decision processes: the time element and lack of information. Based on the "principle of optimality," dynamic programming is used to generate solutions for river basin development problems, in both deterministic and stochastic frameworks. An information variable is developed from the probabilistic properties of stochastic returns function, and introduced into the model. Solution is obtained as a strategy, and decisions are sequential, depending upon information gathering throughout the process.

GIUSEPPE RENSI, Ph.D. California (Berkeley) 1968. The measurement of technical change in California agriculture.

Several variants of two basic linear models, on involving disembodied technical change, the other embodied technical change, are formulated. Sensitivity analysis for changes in the obtained estimates with respect to price base periods is carried out. The empirical complex is the California agricultural sector in the decade 1949-59.

JACK A. RICHARDS, Ph.D. Oregon State 1968. An economic evaluation of Columbia River anadromous fish programs.

Except for anadromous fish, Columbia River water resource products tend to be complementary with dam construction. Coexistence of anadromous fish with dams requires extensive spending for passage and supplemental facilities. Objectives, benefits, and costs were reevaluated to avoid misallocation of resources. This program probably was not economically justified when initiated in the 1930's. However, with past actions taken as given, present and future benefits from sport and commercially harvested fish are estimated to exceed associated costs.

ROBERT J. RIGGS, Ph.D. Wayne State 1968. A conceptual framework for program budgeting by cities.

NORTON ROBBINS, Ph.D. Indiana 1968. The cropland adjustment program in North Carolina: an analysis.

The paper records the findings of a study of the Cropland Adjustment Program (a part of the Food and Agricultural Act of 1965) in North Carolina during the 1966 crop year. This program was designed to remove cropland from farming and convert it to certain conservation uses. A sample was drawn from program participants in ten counties of the Piedmont and Central Coastal areas of the state to determine the characteristics of person-holding contracts. A study of the nature of the contracts in force, the contract properties, and the attitudes of participating farmers and Agricultural Stabilization and Conservation employees is also included. In addition to an analysis of the overall cost and effectiveness of the program, specific proposals are suggested for the improvement of present and future land retirement programs.

JOHN A. ROGALLA, Ph.D. Cornell 1968. Farm business expansion in an economically disadvantaged region of the Northeastern United States.

CLIFFORD S. RUSSELL, Ph.D. Harvard 1968. The recent northeast drought; short-run costs of water shortage and lessons for water system planning.

A model of drought impact is developed, based on interaction between system adequacy and climatic severity. Using this model and data on drought losses from three Massachusetts towns, expected loss functions are derived. These, in turn, are imbedded in a planning model of the inventory type, designed to answer questions about optimal time paths for system expansion, where capacity costs and expected drought losses may be traded off.

BERNARD L. SANDERS, Ph.D. Iowa (Ames) 1967. The effects of agricultural pricing policies in Mexico.

WILLIAM R. SCHRODER, Ph.D. Purdue 1968. Application of systems models to the analysis of selected swine management decisions.

In the feedlot scheduling analysis, a decision policy based on a dynamic programming model was compared with a policy based on budgeting analysis and a policy of buying and

selling at constant weights. Cost and price predictions based on outlook data were used and the decision policies obtained were budgeted over the 5-year period 1959-63.

JOHN P. SEAGLE, Ph.D. Stanford 1967. An allocation model for commercial real estate.

JERRY A. SHEARLES, Ph.D. Iowa (Ames) 1967. Normative production of hogs, beef cattle and other farm products in Iowa.

MORDECHAI SHECHTER, Ph.D. Iowa (Ames) 1968. Empirical decision rules for agricultural policy: a simulation analysis of the feed grain program.

JOHN SIKORA, Ph.D. Colorado 1967. Should the free market control agriculture?: Vector for an econometric examen of farm-problem.

THOMAS E. SNIDER, Ph.D. Minnesota 1967. An economic analysis of equity capital financing in Minnesota dairy cooperatives.

The capital structure of selected dairy cooperatives was analyzed and the cost of capital was estimated. Equity capital was the largest component of capital structure. The minimum cost of equity capital was estimated to be 6.9 per cent; whereas, within limits, debt capital costs 5 per cent. The debt capacity of the sample firm was estimated to determine if the cost of capital could be lowered by the use of more debt. All of the sample firms had unused debt capacity.

MOSTAFA A. SOLIMAN, Ph.D. Iowa (Ames) 1967. Econometric models of the poultry industry in the United States economy.

SOMNUK SRIPLUNG, Ph.D. Iowa (Ames) 1967. Potential in the economic development of Thailand's agriculture.

HAROLD M. STULTS, Ph.D. Arizona 1968. Predicting farmer response to a falling water table: an Arizona case study.

Projection of net returns from typical Pinal County, Arizona farms indicate that the rapidly declining water table will result in substantial reductions in hay and feed grain acreage over time. New income will decline much slower than acreage, however, because under current federal programs net income from cotton is high. In fact, net returns are likely to be affected more by changes in federal cotton programs than by increasing water costs.

LARRY V. SUMMERS, Ph.D. Washington State 1968. Interregional competition within the potato industry of the United States.

EDWIN F. ULVELING, Ph.D. Iowa (Ames) 1967. Return to scale, resource allocation and factor prices in El Bajio, Mexico.

WILLEM VAN VUUREN, Ph.D. California (Berkeley) 1968. Agricultural land prices and returns in an advanced urban and industrial economy.

This thesis attempts to explain the widening discrepancy between U.S. farm income and land values since 1952. Related objectives concern the impact of rising prices and rents upon farm size and income distribution. The application of labor-saving and land-using technologies and increasing land demand for nonfarm use have greatly increased demand, which has not been counterbalanced by readiness to offer land for sale. Increasing land values have resulted in increasingly unequal income distribution in agriculture.

CLAUDE M. VAUGHAN, JR., Ph.D. Kentucky 1967. Covariance analysis of reservoir development effects on property tax base.

The analysis of covariance is utilized to separate the rate of change in the value per acre of land sold since the construction of Wolf Creek Dam and Cumberland Reservoir. The reservoir forms three treatment groups in a heretofore homogeneous geographic unit, which lends itself to analysis through the analysis of covariance technique. The results indicate an expansion of the tax base in the treatment which was inundated relative to the other treatment groups.

JOHN J. WAELTI, Ph.D. California (Berkeley) 1967. The regional economic impact of public water storage through recreational development: a case study.

This study analyzed, on an *ex post* basis, the regional economic impact of reservoir-based recreation in terms of land values, income and employment, and local government finance

over a 15-year period. Policy implications for financing and administering reservoir-based recreation facilities under current legislation, particularly PL 89-72, are discussed.

ALLAN A. WARRACK, Ph.D. Iowa (Ames) 1967. Location analysis of the Iowa feed manufacturing industry: least-cost alternatives.

JOHN C. WEICHER, Ph.D. Chicago 1968. Municipal services and urban renewal.

Cost-benefit analyses of urban renewal have generally not investigated the change in local government expenditures generated by a project. This study seeks to measure these changes. It first develops a model of urban renewal which indicates the qualitative effect of a project on population, housing, and other characteristics of a city. The effect of these characteristics on expenditures for several government services is then estimated. The expenditure reductions generated by one particular project in Chicago are also calculated.

RICHARD N. WEIGLE, Ph.D. Purdue 1967. The economics of the family farm corporation in Indiana.

Objectives were to study the legal structure of the operation in Indiana, to locate and identify Indiana farm corporations, to describe the characteristics of these corporations and to compare the corporate form of organization with other forms of business organization and to evaluate it as to incidence of taxes, growth of the firm, maintaining the continuity and efficiency of the firm, and providing for equitable distribution of income and assets.

RICHARD O. WHEELER, Ph.D. Oregon State 1968. Optimum cattle inventory systems under conditions of certainty and uncertainty—Southeastern Oregon.

The major problem area is the development of a multivariate Bayesian statistical decision theory model relative to selecting an optimal cattle inventory structure. A single multivariate equation model was developed to obtain *a posteriori* probabilities for the unknown state of nature "product price." The factor "range forage" was also an uncertain event. The nature of the problem required structuring an inventory model that reflects growth and which changes in composition of product with respect to time.

WILLIAM H. WITHERELL, Ph.D. Princeton 1967. Dynamics of the international wool market: an econometric analysis.

An annual simultaneous model of the international wool market, consisting of seven supply equations, nine consumption equations, eight stock equations, and four identities is specified and estimated for the years 1949 to 1964. The implications of the dynamic structure of the model, including the reduced form, dynamic multipliers, and the characteristic response function, are analyzed. Shorter-run movements in world prices and consumption are studied by the techniques of spectral and cross-spectral analysis.

JAMES ZINSER, Ph.D. Oregon 1967. Alternative means of satisfying Argentine petroleum demand: importation, governmental production, or foreign private contractual production: a comparative analysis and a recommended petroleum policy.

### Labor Economics

JAMES D. AUGUST, Ph.D. Georgetown 1968. The Phillips Curve for the United States: reviewed and expanded.

This dissertation extended Phillips' concept to other sectors of the U.S. economy and tried to improve manufacturing sector estimates. An important result was that estimates for the U.S. appeared to be unstable. This was due to shifts in variable variances caused by changes in time lag patterns, and casts doubt on the use of such estimates for policy purposes. The results suggested that Phillips curves are local labor market adjustment processes.

WILLIAM M. BAIRD, Ph.D. Ohio State 1968. Collective bargaining by registered nurses.

Although a majority of Ohio registered nurses favor collective bargaining, it is unlikely that this device will rapidly become commonplace in the profession. The principal barriers to collective bargaining in the nursing profession are as follows: (1) legal barriers, in that few states have legislation requiring hospital administrators to bargain; (2) the monopolistic



labor market structure for nurses, which is dominated by the hospital; (3) the attitudes of hospital administrators toward collective bargaining, which are almost uniformly unfavorable.

SIDNEY M. BLUMNER, Ph.D. Arizona 1968. Changes in the interindustry wage structure in California manufacturing industries.

This study investigated the factors that were associated with high-wage-paying industries in the California manufacturing interindustry wage structure during the years 1954-1962. To investigate the variables that were associated with high-wage-paying industries rank order correlation and multiple correlation techniques were utilized. The study concluded that productivity was one of the variables associated with high-wage-paying industries in the California manufacturing interindustry wage structure.

LESTER O. BUMAS, Ph.D. New York 1967. The supply of engineers, 1950-1965.

BENJAMIN BURDETSKY, Ph.D. American 1968. An analysis of Sections 201 and 205 of the Labor Management Reporting and Disclosure Act of 1959 and their impact on union financial management policies and practices.

This dissertation concerns Sections 201 and 205 of the Labor-Management Reporting and Disclosure Act which deals with union registration, financial reporting, and public disclosure. The study establishes the nature of union financial policies and practices before 1959, analyzes the Act's administration by the Department of Labor, and determines the nature of such policies and practices today. The study concludes with a determination as to the impact that these Sections have had since the Act.

ALVIN A. COOK, JR., Ph.D. Washington 1968. The demand for cooperating labor in manufacturing industries, 1947-1964.

JAMES S. CRABTREE, Ph.D. Wisconsin 1967. The structure of related instruction in Wisconsin apprenticeship programs.

Apprenticeship-related instruction in Wisconsin is a complex educational process, having policies, codes, rules, and regulations established and administered by seven major institutional groups. The policies formulated by these groups support and assist in interpreting the concept of related instruction which forms a part of the comprehensive apprenticeship law. The purpose of this study was to describe in detail how these rules and regulations affect the structure of related instruction. Subordinate to the primary purpose, an attempt was made to delineate ways of improving this education process for apprentices. Specifically, eight areas were studied: school and trade programs, policies and administration, required hours and attendance patterns, enrollment, curriculum, structure of classes, instruction staff, and instruction cost.

GEORGE F. C. DE MENIL, Ph.D. Mass. Inst. Technology 1968. Three essays on wage change in United States manufacturing.

The first essay is an extension of Perry's wage equation for U.S. manufacturing. Non-linearities in the relationship between the rate of change of money wages and the explanatory variables are tested. In the second essay a bargaining theory of wage determination in the short run is developed from the Nash game-theoretic solution to the bargaining problem which leads to an equation for the level of the equilibrium wage rate similar to equations developed by Kuh and Sargan. In the third essay the hypothesis is tested that a productivity, distributed by lag relation explains significantly more of the variance of the quarterly rate of change of wages than the Phillips curve.

MICHAEL D. EVERETT, Ph.D. Washington (St. Louis) 1967. The role of the Mexican trade unions, 1950-1963.

RUTH A. FABRICANT, Ph.D. California (Berkeley) 1967. Regional labor markets and migration: an analysis of gross migration in the United States, 1955-1960.

ROBERT M. FEARN, Ph.D. Chicago 1968. Labor force and school participation of teenagers.

The study seeks to identify the major economic determinants of teenage labor force and school participation and to estimate their separate influences. Particular emphasis is given to the interrelation of school and labor force choices in a multiple regression model employing cross-sectional data drawn largely from the 1960 Census.

SIDNEY R. FINKEL, Ph.D. North Carolina 1968. The general theory of production and the theory of unions, wages, and employment.

This dissertation examines the role of marginal productivity theory in the analysis of union behavior. It argues that the simple marginal productivity theory cannot be used to explain union behavior because of the restrictiveness of the assumption of variable coefficients. In addition to substitutable factors of production, limitational factors and limitative factors are introduced into the analysis and all three are used to explain probability of success of union organization and bargaining. The conclusion is that the more general theory of production can give far greater insight into the behavior of economic institutions such as trade unions than can the simple production theory associated with marginal productivity theory.

ANTHONY C. FISHER, Ph.D. Columbia 1968. The supply of enlisted volunteers for military service.

RICHARD B. FREEMAN, Ph.D. Harvard 1968. The labor market for college graduates.

This study examines the college labor market in the postwar period in two ways. First, by a statistical examination of changes in the fields of study elected by students and in the starting salaries of graduates. This analysis employs (a) a cobweb model and (b) a "dis-equilibrium adjustment" model based on discounted lifetime incomes. Second, a survey of 11,000 students in Boston gathered data regarding labor market information. Students are well informed about relative earnings.

ALLAN GART, Ph.D. Pennsylvania 1967. An unemployment study.

This study is concerned with the structural relationship between prices, wages and unemployment in the postwar economy. The major model consists of the maximization of a social preference function subject to a set of linear constraints in the form of an aggregate econometric model. The purpose of this model is to generate optimal operational levels for the components of GNP necessary to reach an employment goal of 97 per cent of the civilian labor force in 1970.

HARRY GRAHAM, Ph.D. Wisconsin 1967. History of the formation of western pulp and paper workers.

In this study the author examines the points made by both the critics of the labor movement and the growth theorists with reference to the development of a specific union the International Brotherhood of Pulp, Sulphite and Paper Mill Workers. He has followed the growth of the union from the formation of the Pulp Workers in 1906 as a result of a dispute within the International Brotherhood of Papermakers, Pulp, Sulphite and Paper Mill Workers to the establishment of the independent Association of Western Pulp and Paper Workers in May 1964. The study represents three years of intensive examination of the documents of the union, and it includes information from personal interviews with participants.

MICHAEL J. GREENWOOD, Ph.D. Northwestern 1967. Determinants and patterns of labor migration in the U.S.A. 1955-1960.

OMAR E. HASSANEIN, Ph.D. Indiana 1967. An evaluation of the company performance criterion as an indicator of wage rate changes.

The purpose of this thesis is to develop a model for measuring the relationship between the economic performance of a company and changes in its wage rates. Profitability, productivity and measures of financial strength were used as indexes of economic performance. The study concentrates on U.S. Steel to test the validity and applicability of its assumptions. The Sinclair Oil Company was also studied to show how the company performance effect on wage trends differs from one company to another depending upon the industry in which the company operates, productivity trends for the company compared to the productivity trends in other sectors of the economy, the position of the company in its industry, and other economic and institutional factors surrounding company operations and affecting its performance.

DONALD W. JARRELL, Ph.D. Pennsylvania 1968. A history of collective bargaining at the Camden area plants of the Radio Corporation of America with special attention to bargaining power.

This history focuses upon two main questions: How do the characteristics of the bargaining parties relate to bargaining power and how does bargaining power relate to the behavior

of the parties? The study offers a view of six local unions—a professional engineers' union, a technicians' union, an office-and-clerical employees' union, a transportation workers' union, and two production-and-maintenance employees' unions—within a single administrative unit.

ALICE H. KIDDER, Ph.D. Mass. Inst. Technology 1967. Interracial comparisons of labor market behavior.

This study probes the evidence that Negroes of comparable worker quality earn at a lower rate than whites. Regression analysis of racial samples showed that, after standardizing for a variety of worker quality variables, Negro wage rates trailed those of whites. Relative wage disparities tended to diminish, however, with higher levels of worker quality. A majority of the Negro sample said they had never encountered discrimination. It is suggested that the self-limitation of job search, coupled with the unfavorable distribution of low-wage industries in the ghetto, combine to produce lower wages.

DAVID E. KIDDER, Ph.D. Mass. Inst. Technology 1967. Education and manpower development in India: middle-level manpower.

This thesis examines the relationship of market forces to public and private policies toward the development of middle-level technical personnel. When qualitative differences among technicians and among firms were admitted into the analysis, a "structure of shortage" was shown to exist. Small firms face a chronic shortage, revealed in high turn-over rates, of highly qualified, experienced technicians. Firm behavior and policy in sponsoring in-plant training programs and making use of technical education appeared reasonable in light of the analysis of shortage.

JEROME B. KOMISAR, Ph.D. Columbia 1968. Unemployment compensation and the duration and rate of unemployment.

Three hypotheses, implied by a theoretical analysis of possible relationships between the payment of unemployment compensation and the duration and rate of unemployment, are tested. They are that the availability and magnitude of unemployment compensation: (1) will increase the duration of unemployment; (2) will increase the measured rate of unemployment; and (3) will have a positive effect on the cyclical rise in the rate of unemployment and a detailed analysis of duration of unemployment data support the first two hypotheses and lend credence to the third.

RONALD S. KOOT, Ph.D. Oregon 1967. The determinants of money wage changes in underdeveloped countries: a study of Mexico and Chile.

JOHN D. LAGES, Ph.D. Iowa (Ames) 1967. The CIO-SWOC attempt to organize the steel industry, 1936-1942; a restatement and economic analysis.

CHARLES W. LANGDON, Ph.D. Alabama 1967. Manpower development training in Alabama.

PATRICK LENTHAN, Ph.D. Wisconsin 1968. The economic effects of the Wisconsin minimum wage orders.

THOMAS LOVE, Ph.D. Wisconsin 1968. The impact of teacher negotiations on school system decision-making.

This study is a survey and analysis of the extent of teacher participation in decision making, the nature of collective negotiation and alternative decision processes, the scope of various decision processes, and the factors which determine whether negotiations or other processes are applied to particular types of policy decisions. The implications for the professional role of teachers, managerial efficiency in the schools, and the nature of educational policy decisions are explored in detail.

LEON E. LUNDEN, Ph.D. Wisconsin 1967. Major symphony orchestra labor relations.

The dissertation notes the improving economic status of symphony orchestra musicians and the movement towards year-round employment in a traditionally seasonal industry. The components of the major orchestra industrial relations system are examined and the results of their interaction analyzed. The analysis covers the symphony orchestra association, the American Federation of Musicians, symphony orchestra musicians, major collective bargaining issues, and an extensive study of the labor market for symphony musicians and how it operates.

LAWRENCE E. MCKIBBIN, Ph.D. Stanford 1968. A comparison of the impact of an executive development program on owner-entrepreneurs and employee-managers.

JEAN-LUC MIGUE, Ph.D. American 1968. The theory of the occupational wage structure: an application to the Canadian experience.

The dissertation seeks to appraise existing theories dealing with movements in the differentials between skilled and unskilled wages and to assess the explanatory power of the theory of investment in education in determining historical changes in labor supply. While consistent with the theory, the results suggest that the response of people to rates of return on investment in education was significantly hindered and, at times, dominated by factors related to economic development, such as urbanization, foreign migrations, the level of income, etc.

DANIEL Q. MILLS, Ph.D. Harvard 1968. Factors determining patterns of employment and unemployment in the construction industry.

The purpose of this thesis is to measure and explain the major fluctuations in employment and unemployment which occur in construction, and their relationship. The determinants of the seasonality of employment are isolated and measured. Nonseasonal variations in manpower demand are analyzed. The flexibility of the industry's labor force is investigated, and major limitations to greater flexibility are identified. The impact of the federal government on the industry is described, and certain policy suggestions discussed.

HOSSEINE MOREWEDGE, Ph.D. Columbia 1968. The economics of casual labor: a study of the longshore industry.

KONOSUKE ODAKA, Ph.D. California (Berkeley) 1967. A study of employment and wage differential structure in Japan.

THOMAS H. PARK, Ph.D. Vanderbilt 1968. Nonlocal job information in a low-income rural area: the Tennessee Upper Cumberland.

DONALD E. PURSELL, Ph.D. Duke 1967. Minimum wage regulation under the South African Wage Act.

JOSEPH R. RAMOS, Ph.D. Columbia 1968. The labor force in post-World War II Latin American development.

Trends in the size, quality, and sectoral distribution of Latin America's labor force are analyzed. It is argued that the profitable introduction of a modern skill-using technology accounts for the strong rise found in average labor quality since World War II. The slow growth of manufacturing employment is found linked to the faster than average growth in the quality of its sectoral labor force, whereas the converse is true of the tertiary sector.

DONALD E. RONS, Ph.D. Purdue 1967. A comparison and evaluation of career progress of Purdue engineering and science alumni who graduated with Bachelor of Science, Master of Science and Doctor of Philosophy degrees between 1950 and 1964.

DAVID P. ROSS, Ph.D. Duke 1968. The economics of privately negotiated technological change provisions.

DELWIN A. ROY, Ph.D. Purdue 1968. The Zonguldak strike: a case study of industrial conflict in Turkey.

HIRSCH S. RUCHLIN, Ph.D. Columbia 1968. Manpower resources of the U.S. maritime industry: a definitional and descriptive analysis of the maritime labor force.

ARTHUR MCC. SHAEFER, Ph.D. Pennsylvania 1967. Presidential intervention in labor disputes during the Truman Administration: a history and analysis of experience.

The motives, powers and techniques of Presidential intervention are analyzed. Motives derive from basic responsibilities which preclude Presidential aloofness from involvement in labor disputes. Powers derive from powers lodged in the Presidency by law and precedent, their efficacy depending on the nature of the dispute and Presidential prestige. Techniques of intervention, analyzed in terms of their availability, efficacy and desirability are mediation, fact-finding, voluntarism, use of troops seizure-injunction and Taft-Hartley procedures.

ARIE SHIROM, Ph.D. Wisconsin 1968. Industrial cooperation and adjustment to technological change: a study of joint union-management committees.

This thesis explores the current role of joint union-management committees in dealing

with technological change issues. It is limited to unionized industrial companies, and to committees established by both sides outside the realm of collective bargaining. The main objective of the study is to present a factual picture of actual experiences gained with joint committees in Minnesota, Illinois, and Wisconsin so that labor unions, management, and public authorities may make a more informed evaluation of the potential role of the committee in adjustment to technological change. The organizational and labor market correlates of these joint committees are also considered in the analysis.

BERTRAM SILVERMAN, Ph.D. Columbia 1967. Labor and left-fascism: a case study of Peronist labor policy.

GARY SORENSON, Ph.D. Claremont 1968. The effect of income changes on labor force participation: a theoretical analysis.

Lack of convincing evidence on the effects economic variables have on labor force participation and the near absence of theoretical advances in this area motivated this theoretical analysis. Nonlinear programming is applied to a production-consumption model of the household based upon Gary Becker's 1965 *EJ* article on time allocation. Empirical implications are generated from parametric changes, the predictions depending on effects in weighted marginal utilities of family income and individual non-work time.

ALLAN D. SPRITZER, Ph.D. Cornell 1968. An analysis of trade union sponsored programs of occupational training in the U.S. seagoing maritime industry.

Although the problems of skill obsolescence and declining employment opportunities have long concerned maritime trade unions, in recent years wartime shipping demands have created an urgent need to supply a sufficient number of adequately trained and experienced merchant seamen. To help resolve these divergent job market problems, virtually all maritime trade unions, since the beginning of 1966, have sponsored some form of occupational skill training, retraining, or upgrading for their members. This research attempts to examine the specific nature, objectives, scope, and results of these programs and to evaluate the extent to which they can be expected to relieve short and long-run problems of adjustment of the maritime labor force to skill and manpower need in the industry.

JOHN K. STEPHENS, Ph.D. Illinois 1967. Differentiation of labor in macroeconomic growth models.

BEVERLY S. TANGRI, Ph.D. California (Berkeley) 1967. Federal legislation as an expression of United States public policy toward agricultural labor, 1914-1954.

MIGUEL URRUTIA, Ph.D. California (Berkeley) 1967. The development of the Colombian labor movement.

SUE VAN ATTA, Ph.D. California (Berkeley) 1967. An analysis of overtime hours for production workers in manufacturing industries, 1957-1965.

ROBERT WERNER, Ph.D. Wisconsin 1967. Some institutional aspects of the labor market in a depressed area.

DAVID C. WHYBARK, Ph.D. Stanford 1967. A model for the demand and supply of airline flight crews.

### Population; Welfare Programs; Consumer Economics

TONY H. BONAPARTE, Ph.D. New York 1967. An analysis of the racial and cultural influences on the business system in Trinidad, West Indies.

WILLIAM C. BONIFIELD, Ph.D. Wisconsin 1967. The economics of the ministry: an analysis of demand and supply of Protestant clergy.

This is an attempt to apply labor market analysis to the ministerial labor markets. It describes the operation of the three types of labor markets which allocate ministerial labor. It contrasts the views of employers (lay church officers) and employees (ministers) in order to explain some of the imperfections observed in the markets. Data are taken from mail surveys of ministers and laymen in three denominations and five midwestern states.

DENNIS COX, Ph.D. Stanford 1968. Two essays in the distribution of population.

This dissertation has two major parts. In the first, "economies of agglomeration" are

measured by means of regressions in which population density "explains" income per worker in counties. In the second, interstate migration in the United States is examined through analysis of variance; age, income, term of residence, and income change are used to "explain" the incidence of migration. The analysis is based on the Social Security Administration's one-per cent sample of employee records.

ROLF V. CRAFT, Ph.D. Iowa (Ames) 1968. Variations in the costs and income benefits of undergraduate education at Iowa State University.

RONALD W. CROWLEY, Ph.D. Duke 1968. The nature and social cost of in-migration to cities in the United States, 1955-60.

C. HOWARD DAVIS, Ph.D. Vanderbilt 1968. Determinants of mobility of college educated persons: 1955-60.

KENNETH M. DEITCH, Ph.D. Harvard 1967. An econometric analysis of the demand for American public education in the 1960's, with a statement of the general economic case for public education.

The thesis contains two related but distinct parts: first, an attempt to use primarily pre-Marshallian "welfare economics" to explain why the market is not reliable as a mechanism for allocating resources to education. The second part of the thesis asks: what are the determinants of current expenditure in America's public schools? Specifically, is it helpful to have a model which includes variables other than income? The answer to this question is a qualified yes.

GOPAL C. DORAI, Ph.D. Wayne State 1967. Economics of international flow of students—a cost-benefit analysis.

LOUIS ESPOSITO, Ph.D. Boston College 1968. An analysis of the economic factors determining the number of applicants to medical school.

This dissertation attempts to ascertain (1) whether the number of applicants to medical school responds to long-run disequilibrium in the market for physicians' services and (2) what economic factors influence the number of applicants to medical school. Multiple linear regression is used with time-series and cross-section data. The study concludes (1) that the number of applicants is not responsible to long-run disequilibrium and (2) that the critical factor determining the number of applicants is the availability of financial aid.

ROBERT L. FARRELL, Ph.D. George Washington 1968. An examination of differentiated cross-sectional price, cost, quality, and demand relationships in higher education.

There are many types of student demand for higher educational product, many levels of price, and varieties of quality. Price, cost, quality, demand, control, and productivity measures are defined and developed for the higher education sector of 48 states. By using simple correlation techniques, with the state as the focus of observation, relationships among these forces are examined.

LUCILLE G. FORD, Ph.D. Case Western Reserve 1967. A survey of organizations active in economic education.

A critical survey of ninety organizations active in economic education or "persuasion" is followed by a proposal for an association of such organizations, perhaps under the guidance of the Joint Council, in order to clarify the needs for and approaches to economic literacy.

LEONARD HAUSMAN, Ph.D. Wisconsin 1967. The 100 per cent welfare tax rate: its incidence and effects.

This dissertation contains data which shed light on the question of capacity for self-support among AFDC recipients, on the need to consider the implicit tax rate on earnings in those programs as a determinant of work effort, and on the "employability" of AFDC family heads. The major conclusions are that over 70 per cent of AFDC and over 40 per cent of AFDC-UP family heads are incapable of supporting their families at the levels of income they attain while on welfare; but that larger than conventionally accepted proportions of such persons are "employable" at effective wage rates above zero.

STEPHEN A. HOENACK, Ph.D. California (Berkeley) 1967. Private demand for higher education in California.

DAVID B. JOHNSON, Ph.D. Virginia 1968. The fundamental economics of the charity market.

This thesis is divided into three parts: historical, analytical, and a statistical appendix.

The analytical section considers the effects on the marginal conditions in a two-man economy when one individual's welfare enters the utility function of the other. It also considers charity in a large numbers case and it examines the individual's decision calculus when deciding between the political and charity markets. The appendices include an analytical discussion of tax and expenditure effects, as well as a complete compilation of statistics pertaining to the sources and uses of charitable funds.

EUGENE L. JURKOWITZ, Ph.D. Columbia 1968. An estimation of the military contribution to human capital.

JOSE D. LANGIER, Ph.D. Michigan State 1967. An economical evaluation of the nutritional contribution of food.

To improve the nutritional status of individuals, there is a need for a measure of the nutritional contribution of food. This thesis suggests four new measures of the nutritional contribution of food when there are deficiencies of one or more nutrients. It applies the deficiency-weighted sum of the nutrients to find economical supplementary diets for poor and very poor families of Northeast Brazil.

MARY L. LARMORE, Ph.D. Northwestern 1967. An inquiry into an econometric production function for health in the United States.

We constructed two health production functions: (1) a single equation model, studying U.S. counties, regressing the physician-population ratio and several economic or demographic variables upon the county mortality rate. (2) A three-equation model, focusing on individuals' health, using disability days and the probability of dying as health proxies. Other variables in the model are physician visits, income, sex, age, and region. Empirical results suggest that bed disability enters health production as an input.

LEE E. LAYTON, Ph.D. Minnesota 1967. Medical care and economic security: a study of selected foreign programs.

This dissertation investigates the structure and operation of alternative, government-sponsored programs through which at least some of the costs of medical care are paid. The focus of concern is upon the economic security of the individual consumer of medical services. It assumes that all households should be protected against economic insecurity caused by medical expenses and is primarily concerned with the question of how to achieve this objective with minimum cost.

COTTON M. LINDSAY, Ph.D. Virginia 1968. Supply response to public financing of medical care in the United States.

Models are developed of the pricing behavior in the physician care and hospital care sectors of the medical care industry. These models are employed to predict industry response to the Medicare-Medicaid legislation. These results are compared to optimum efficiency conditions developed for the production of goods and services for the consumption of which reciprocal externalities exist. Finally, the results of these measures are compared with those of other regimes designed for this same purpose.

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RICHARD L. MILLS, Ph.D. Indiana 1967. A transition matrix approach to migration analysis and population forecasting.

This thesis introduces a cohort-survival population forecasting model with a transition matrix migration component. The forecasting accuracy of this model is tested against two other models which differ only in their migration component. In forecasting the U.S. population from 1950 to 1960 (by Census Division and age-group) the transition matrix model was just as accurate as the other two models and usually more accurate than the traditional cohort-survival model which uses a rate of net-migration.

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TUNC OZELLI, Ph.D. Columbia 1968. The examination of the costs and returns of college education.

PHILIP D. PATTERSON, JR., Ph.D. Georgetown 1968. A fiscal analysis of fixed amount federal grants-in-aid: the case of vocational education.

A fiscal analysis of fixed amount federal grants using the criteria of effectiveness, efficiency, and equity is essential to an evaluation of the federal grant structure and provides a necessary counterpart to a PPBS approach. The federal grant program for vocational education is used to demonstrate how the suggested fiscal analysis can be employed to study the general issues of matching requirements, equalization, conditional aid and fiscal impact and the specific issue of program need.

MARK V. PAULY, Ph.D. Virginia 1967. Efficiency in public provision of medical care.

This is a study of the efficiency of alternative institutional arrangements through which the demand for medical care may be expressed. A rationale for public provision of medical care was obtained from a general notion of external benefits arising from individuals' consumption of medical care. Criteria for efficiency in the provision of care were derived from theoretical welfare economics. Existing arrangements for public provision in the United States and Great Britain were analyzed with these criteria.

JERRAL C. RAYMOND, Ph.D. Virginia 1967. Production of knowledge by economists.

Using a sample population of American economists, this study investigates relationships between (1) the production of knowledge in the form of publications, and (2) certain biographical characteristics in the life histories of the individuals in the sample, such as age at reception of the doctorate, age at publication debut, source of doctorate, and type of employment.

DANIEL C. ROGERS, Ph.D. Yale 1967. Private rates of return to education in the United States: a case study.

ELWOOD W. SHOMO, Ph.D. Rutgers 1968. Social insurance for women.

This study discusses the role of women in the design of social insurance programs under the major historical approaches to income maintenance and the specific schemes which have been offered. Cross-national comparisons are made of the type and size of old age, survivors, health and unemployment benefits. In addition, five important economic considerations faced by designers of social insurance programs are discussed including the earnings rule, differential contribution rates, dependents' allowances under wage-related benefit schedules, "blanketing-in" of previously uninsured individuals, and the income redistribution aspect of family allowances.

ISMAIL A.-H. SRAGEL-DIN, Ph.D. Michigan 1967. Non-market components of national income.

DAVID A. A. STAGER, Ph.D. Princeton 1968. Monetary returns to post-secondary education in Ontario.

This study presents social and private net present values, benefit/cost ratios and internal rates of return to investment in: (1) different university faculties and other post-secondary institutions in Ontario in 1960-64; (2) hypothetical year-round operation of these institutions; and (3) the hypothetical introduction of community colleges. These returns are larger than generally have been found for the United States and Great Britain; they also vary widely among the different faculties and institutions due to major labor market imperfections.

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JOHN G. GURLEY

*Editor of the American Economic Review*  
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## THE PRICE EQUATION

By OTTO ECKSTEIN AND GARY FROMM\*

Prices have occupied the center of the stage of economics for most of the last century. Yet they remain among the emptier boxes of econometrics. Studies started in the 1920s, seeking to measure supply and demand curves, foundered on the identification problem. Thereafter, econometricians were preoccupied with other matters. Recently, Wilson [22], Kuh [12], Klein and Ball [11], Fromm [9], Schultze [20] and others started a new line of research on prices, seeking to explain changes in sectoral price indexes through cost and demand factors.<sup>1</sup>

The present paper presents some new, statistical results for U. S. manufacturing prices. The equations test the two dominant micro theories of pricing: (1) the supply-demand, competitive mechanism; and (2) the target return, full cost, oligopolistic pricing mechanism. They also provide first approximations for the lag structures of demand and cost factors on price, test for asymmetries in pricing, and serve as a framework for a historical review of recent inflations.

The equations are fitted to quarterly price indexes for all manufacturing, and for durables and nondurables. The study is part of a program to build a complete model of the price-wage-productivity-cost structure of U.S. industries.

### *\*I. Theory of Price: Supply and Demand*

In the classic, competitive market, price responds to the difference between demand and supply. In the limiting case, supply and demand stay in continuous balance through instantaneous price changes.

Continuous clearing is an efficient market mechanism only in certain

\* The authors are professor of economics, Harvard University, and senior fellow, The Brookings Institution. This paper was prepared while the former was a fellow of the Center for Advanced Studies in the Behavioral Sciences. The research was partially supported by grants from the National Science Foundation to Harvard University and to the Brookings Econometric Model project. We are grateful to James A. Craig, Michael D. McCarthy, Michael Hicks and Nancy Bower for skillful aid in preparing this paper. We also thank Stanley Black, Robert Dorfman, Marc Nerlove, Lester D. Taylor, and Thomas A. Wilson for helpful comments.

<sup>1</sup> Other studies include Dow [6], Conrad [4], Levinson [13], our earlier paper on steel prices [8], Yordon [24], Neild [15], Perry [16], and Bodkin [2].



situations where the cost of changing prices is negligible, transactions are sufficiently numerous for buyers and sellers to remain in communication, and losses from failing to effect a transaction are high. In many other cases, continuous clearing is inefficient: goods with high inventory-carrying costs or with variations in design will be produced in response to orders; goods that are produced in batches will usually require maintenance of an inventory sufficient to meet demand over an interval. The cost of price change may be too great, and where a product line is complicated, frequent price change may exceed managerial capabilities. In the case of companies with a large sales force, continuous clearing would require a decentralization of decision-making which would not be optimal from the firm's (or perhaps even the economy's) point of view. Indeed, the continuous-clearing case, where production equals supply and supply equals demand, is probably an exception. Disequilibrium is the more common situation.

Figure 1 portrays a more typical market which can still be characterized as competitive.  $S_0$  is the short-run supply curve reflecting the short-run marginal costs of production.  $D_0$  is the short-run demand curve, reflecting the volume of active attempts to purchase at various prices. If there is excess demand at a price  $P_0$ , the following reactions might occur: (1) Suppliers will reduce their inventories below preferred levels to meet their customers' demands. (2) Some of the demands will not be met, but purchasers might agree to take delivery later; their orders are put into the backlog of unfilled orders. (3) Some orders may be abandoned because potential purchasers need early delivery. (4) Firms may increase prices to raise their profits, believing that purchasers cannot turn to alternative sources. (5) The price increases lead to larger short-run supply, reduced demand, and diminution of the disequilibrium.

Figure 1 shows these reactions. The line  $S_1$  shows the effective supply curve in the very short run, the "disequilibrium supply curve." It reflects not only cost conditions, but also the extra supply obtained from the undesired drawdown of suppliers' inventories below their optimal level.  $D_1$  is the "disequilibrium demand curve," reflecting the orders that are either satisfied or added to the backlog. The distance  $ab$  reflects demand matched by current production;  $bc$  is the undesired inventory drawdown;  $cd$  is the buildup of unfilled orders, and  $de$  is the volume of abandoned orders. At the equilibrium point,  $f$ , supply is equal to demand in the short run. Each supplier holds his optimal stock of inventories; production matches orders and shipments; each purchaser obtains the full amount he wishes at the going price.

When supply exceeds demand, these processes go into reverse. Production, and hence short-run supply, exceeds short-run demand, as existing order backlogs are satisfied. Producers' inventories may be restored

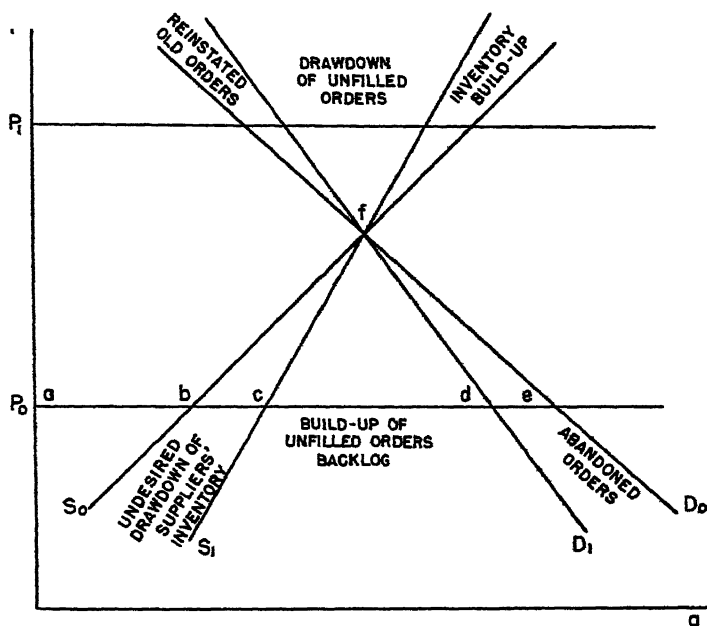


FIGURE 1. PRICE DISEQUILIBRIUM

to their optimal level, and there may be some undesired accumulation. As these stock adjustments proceed, the downward pressure on prices increases.

The supply-demand price mechanism, algebraically, is usually specified as:

$$(1) \quad \frac{\Delta p}{p} = \frac{(d - x)}{p}$$

where  $\Delta p/p$  is the rate of price change,  $d$  is short-run demand,  $x$  is short-run supply or production, and  $s$  is sales. Letting  $d'$  equal the orders that are not abandoned, we can write:

$$(2) \quad d - x = (d - d') + (d' - s) + (s - x),$$

where the first term measures abandoned orders, the second term the change of unfilled orders, and the third inventory change. These expressions correspond to the segments of the line  $be$  in Figure 1. There is no reason why the quantitative response of prices to the three types of disequilibrium should be the same, so different coefficients can be attached to the three terms in (3). Thus,

$$(3) \quad \frac{\Delta p}{p} = \alpha_1 \frac{d - d'}{p} + \alpha_2 \frac{d' - s}{p} + \alpha_3 \frac{s - x}{p}$$

This formulation relates price changes strictly to disequilibria among current flows of production, orders, shipments, and inventory investment. However, prices could also be influenced by the previous history of these flows, which in some cases is reflected in current stocks. Thus the level of unfilled orders, the deviation of the stock of inventories from the desired level, and the relation between recent average production levels and capacity output could also have an influence.<sup>2</sup>

Statistical measures are available for several aspects of disequilibrium. Unfilled orders are reported for some industries and proxies can be devised for inventory disequilibrium. But coverage is incomplete, and the figures are defined for periods which may be relatively long in comparison to the speed of change of the disequilibria. Further, in many markets there is almost continuous clearing so that disequilibrium phenomena do not emerge. In this situation, the movements of supply and demand curves directly determine price changes. Therefore, a full statistical treatment of the classical mechanism requires that the determinants of changes in supply and demand curves also be identified.

The traditional theory of the firm yields the necessary relationships. Setting aside the disequilibria among production, shipments, orders, and inventories, let the firm maximize its short-run gross return to capital,

$$(4) \quad Z = px - wL(x) - p_m mx,$$

where  $x$  is output,  $w$  the wage rate,  $L(x)$  total man hours,  $p_m$  material prices, and  $m$  material inputs per unit of output.

Profit maximization requires that

$$(5) \quad p = w(dL/dx) + p_m m,$$

and hence

$$(6) \quad \partial p / \partial w = dL/dx; \quad \partial p / \partial p_m = m.$$

More generally, short-run profit maximization results in the following formula for discrete price change, assuming the change in marginal cost to equal the change in unit variable costs, and omitting the second order interaction terms:

$$(7) \quad \Delta p = w\Delta(L/x) + (L/x)\Delta w + p_m \Delta m + m\Delta p_m.$$

Thus the change in price in a period is the sum of changes in unit labor and material costs, which in turn depend on changes in the wage rate and

<sup>2</sup> Samuelson [18, p. 268] and Clower and Bushaw [3] have explored the theoretical characteristics of such models.

unit labor requirements, and changes in material prices and unit material requirements. Let us call unit labor costs  $ULC$ , and unit material costs  $UMC$ .<sup>3</sup>

The traditional version of the classical theory of the firm calls for no direct influence of the size of the capital stock on short-run, profit-maximizing, price-output decisions; the capital stock makes itself felt through the short-run cost curve.<sup>4</sup> However, this particular dynamic sequence is highly specialized, and a more general formulation, still in the spirit of the classical system, would leave room for direct influence of the size of the capital stock on price. When the current rate of production is low in relation to the industry's capacity, i.e., when the industrial operating rate is low, firms will reduce prices as they seek to boost sales and production to permit a better utilization of capacity and thereby to raise profits. Conversely, when production is very high, so that the operating rate of capacity is beyond the optimal, signalling the need for additional capacity, firms will increase price. In other words, the optimal contribution to overhead will vary with the operating rate; actual pricing behavior looks not only to the short-run cost curves, but also reflects the relationship between the existing capital stock and the current rate of production.

Industrial operating rates have proved to be a variable of importance in numerous econometric investigations. They reflect not only the imbalance between long-run productive capacity and current production but also other forces. When operating rates are high, disequilibrium in product markets will be more frequent and larger. Inevitably, high operating rates are associated with delivery delays, shortages, and changes in the nonprice terms of transactions, such as freight absorption and the provision of "extras." These phenomena, in time, are likely to lead to price change.

Pricing, in most situations, is conducted under conditions of uncertainty; the firm that takes the initiative, even in the competitive case, does not know whether other companies will promptly adopt the same price change. Since it does not know its demand curve, it cannot be certain of the response of its sales to the price change. To be sure, these problems cannot arise for the price taker of perfect competition. But some elements of locational or product differentiation attach to the sales of most companies in sufficient degree to create some uncertainty in

<sup>3</sup> In the case of monopolistic competition, where the firm faces a demand curve with finite elasticity, the right-hand expression in equation (5) is multiplied by the well-known markup factor derived from the elasticity of demand.

<sup>4</sup> Alternatively, short-run cost can be defined to include the quasi-rent on capital, with the quasi-rent varying with the rate of utilization. However, the traditional exposition does not solve explicitly for the quasi-rents and hence leaves the influence of the utilization of capital vague. Actual measures of short-run cost exclude quasi-rents on capital.

pricing. When operating rates are high, a firm can feel more confident that an increase in price will not produce a serious loss in sales. Customers will not be able to establish new supply connections and will therefore be more likely to pay the higher prices.

Industrial operating rates also bear a close relation to costs. When the rates are high, the cost of purchased materials and supplies increases. A recent econometric study finds that the operating rate of manufacturing industries strongly affects the movements of input material prices.<sup>5</sup> Further, the operating rate also shows where the industry is operating on its short-run cost curve. Up to the optimum point, a rising operating rate should mean falling costs and therefore lower prices. Beyond that point, operating rates are associated with rising costs and higher prices.<sup>6</sup>

In summary, the classical model of price determination can be tested by an equation which contains three elements: (1) Disequilibrium phenomena such as changes in unfilled orders and disequilibrium of inventories; (2) factors influencing variable costs, such as unit material costs and unit labor costs; and (3) factors reflecting the balance between current production (or demand) and the industry's capital stock, such as industrial operating rates.

## II. *Theory of Price: Target Return and Full Cost Pricing*

In oligopolistic industry, the pricing decision is subject to greater uncertainty because of interdependent reaction. If a price increase does not succeed, i.e., if the other companies do not follow, the loss in sales, profits, good will, and prestige can be great. The oligopolistic firm is likely to possess more discretion, and therefore to view the pricing decision in a longer-term perspective. Given the institutional character of modern corporate management, and the emphasis on long-run security and expansion of the company, management is less likely to attempt to equilibrate supply and demand in the short run. It will not change prices frequently. When demand rises, more of the burden of market adjustment will fall on rationing and backlogs of orders, particularly since purchasers have fewer alternative sources of supply. When demand falls, more of

<sup>5</sup> Faith Halfter (Ando) [1].

<sup>6</sup> In his comments on this paper at the December 1967 AEA meetings, Stanley Black suggested that equation (1) be reformulated to incorporate capacity used at its optimal level instead of production as the appropriate concept of flow supply. He also proposes that excess demand be defined as the difference between flow-demand plus unfilled orders and flow-supply plus inventories. He proposes that we write:

$$(1') \quad \frac{\Delta p}{p} = \frac{(\dot{d} + u) - (x_K + h)}{s} = \frac{(\dot{d} - \dot{d}')}{s} + \frac{u}{s} + \frac{\dot{d}' - s}{s} + \frac{s - x}{s} + \frac{x - x_K}{s} - \frac{h^*}{s} \cdot \frac{h}{h^*}$$

where  $u$  is the stock of unfilled orders,  $x_K$  is capacity output,  $h$  is the stock of inventories, and  $h^*$  is desired inventories. This formulation incorporates all of the demand variables discussed above, albeit in specialized form.

the adjustment will be on lower production, less cutting of price; with demand for each firm less elastic, profit maximization by itself would produce that result.

According to interview studies, a common principle of long-term pricing appears to be to set price to earn a target rate of return on capital at a standard volume of output.<sup>7</sup> Price is altered if the cost of producing the standard output changes, either because of changes in the prices of the main inputs, or because of technological progress. However, price will not respond to cost changes caused by changing operating rates, nor to changes in demand. The target rate of return is based on market structure and long-run economic conditions of the industry, including barriers to entry, international trade barriers, concentration, product differentiation, the necessary quantity and quality of managerial talent, long-run demand elasticities, the degree of risk attached to the profits, and the valuation placed on the firm's equity and debt instruments in the capital markets.

This pricing method has a number of advantages for the large firm. First, it provides a necessary, internal consistency with the target-return investment criterion. Second, it is particularly suitable for price leadership; the leader can either use his own costs, or apply a standard costing procedure which will provide an umbrella for higher cost producers. Third, the method calls for few price changes, a desirable characteristic from the point of view of customers who prefer their costs to be stable and predictable; this factor is particularly pertinent for intermediate goods that are major inputs for large customer companies. Finally, the method is particularly suitable for the long-term supply contracts which are common for materials in heavy industry; the prices in such contracts may reflect labor costs at a normal rate of operation, the target return on capital, and escalator clauses for variations in raw material prices. These escalators shift the risk of fluctuations in volatile raw material prices to the final product producer, who, in turn, will attempt to pass such cost increases forward.

Given the diverse goals of various levels of management of the large enterprise and the variety of market circumstances for different types of products, target-return pricing will rarely be found in pure form. The greater the decentralization of an enterprise, the more target-return prices will be modified by market conditions and special customer relationships. Even the largest multiproduct companies price some products on a competitive short-run basis.

Target-return pricing can be expressed as follows:

<sup>7</sup> See Kaplan, Dirlam and Lanzilotti [10]. Also see Eckstein [7] for fuller discussion of these points.

$$p = \frac{\bar{\pi}K}{x^N} + w \frac{L(x^N)}{x^N} + p_m m(x^N), \quad \text{or}$$

$$(8) \quad p = \frac{\bar{\pi}K}{x^N} + ULC^N + UMC^N,$$

where  $\bar{\pi}$  is the target rate of return,  $K$  is the firm's capital stock,  $x^N$  is standard output,  $ULC^N$  is standard unit labor cost, and  $UMC^N$  is standard unit material costs.

A variant of target-return pricing is "full cost" pricing. On this principle, price equals standard unit variable cost multiplied by a markup, or

$$(9) \quad p = (1 + \lambda)(ULC^N + UMC^N),$$

where  $\lambda$  is the markup factor. Its behavioral characteristics are similar to target-return pricing, except that changes in the ratio of capital to standard output do not enter the pricing computation; the firm's policy parameters are the markup percentage and the definition of standard volume. Which principle is more appropriate in a particular industry depends upon production and marketing processes: in industries such as steel, chemicals, or petroleum refining, where strategic decisions focus on physical capital, target-return pricing may be used. For consumer-oriented or technology-intensive goods, where profit depends mainly on the choice and design of products, full cost pricing would more likely be applied.

The hypothesis in (8) implies

$$(10) \quad \frac{\partial p}{\partial w} = \frac{L(x^N)}{x^N}; \quad \frac{\partial p}{\partial \bar{\pi}} = \frac{K}{x^N} \quad \text{and} \quad \frac{\partial p}{\partial p_m} = m(x^N).$$

The total discrete price change, omitting second order interactions, is:

$$(11) \quad \Delta p = \left( \frac{\bar{\pi}}{x^N} \right) \Delta \bar{\pi} + \bar{\pi} \Delta \left( \frac{\bar{\pi}}{x^N} \right) + \Delta ULC^N + \Delta UMC^N.$$

Price change under the hypothesis of (9) omits the first two terms of (11), substituting changes in the markup factor.

In summary, the classical supply-demand mechanism suggests the following variables for an empirically derived price equation: (1) the backlog of unfilled orders (both level and change); (2) the deviation of inventories from their optimal level; (3) changes in unit labor costs; (4) changes in unit material costs; and (5) the industry operating rate.

Target-return or full cost pricing suggests the following variables: (1) changes in standard unit labor costs; (2) changes in standard unit material costs; (3) changes in the standard capital-output ratio; and (4) changes in target rates of return, standard markups or standard volume.

### III. *The Empirical Tests*

#### *Variables*

*Prices ( $p$ )*: Quarterly wholesale prices for all manufacturing, and for durables and nondurables, are the dependent variables. They are computed from the regular monthly Bureau of Labor Statistics wholesale price indexes (*WPIs*). Because they are list prices they are not perfect measures of unit revenues. Transactions prices are more sensitive, and in some industries, changes in list prices ratify preceding changes of transactions prices. For this reason, the length of lags estimated here probably represents their upper limit.

*Unit labor costs (ULC)* are measured by total compensation paid divided by the U. S. Office of Business Economics (OBE) series for real product originating in constant dollars (quarterly interpolation by Brookings).

*Average hourly earnings (AHE)* are quarterly averages of monthly Bureau of Labor Statistics data on earnings of production workers in manufacturing establishments.

*Unfilled orders ( $O_u$ )* is the Census Bureau series measured at the end of the period. The ratio of unfilled orders to sales ( $O_u/S$ ) is the ratio of orders at the end of the period to the average volume of sales during the period.

*Inventory disequilibrium* is measured by the deviation between the actual inventory-sales ratio at the end of a period and a twelve-quarter moving average of that ratio. The moving average reflects gradual changes in desired inventories because of improved inventory control procedures and other technological changes. If the actual inventory-sales ratio exceeds the trend ratio, inventories are assumed to be greater than desired levels, and therefore should exert a downward pressure on prices. Conversely, a low inventory-sales ratio should raise prices.

*Material input prices ( $p_m$ )* are special indexes prepared by Dr. Faith Halfter Ando. These indexes are composed only of crude raw materials.<sup>8</sup> The published materials price indexes are not suitable for price equations because they include a considerable share of semifinished goods which are actually value added of manufacturing.<sup>9</sup> No attempt has been made to normalize material costs, or to identify changes in unit material requirements.

*Industrial operating rates ( $x/x_K$ )* are the Wharton School indexes pre-

<sup>8</sup> [1] In the case of the durables and nondurables indexes, the output price index of the other sector was included with its input-output weight.

<sup>9</sup> For example, the published index of materials for durable manufacturing has such a large component of what are in fact output prices (and hence the dependent variable), that correlations employing this index are virtually perfect and attach the wrong signs to most of the variables.



pared by Klein and Summers, using the Klein-Preston correction.<sup>10</sup>

*Standard Unit Labor Costs:* To estimate standard unit labor costs it is necessary to correct actual unit labor cost for short-run swings in productivity. Earlier studies [23] have found that short-run productivity is determined by: (1) the long-term productivity trend reflecting technology and capital; (2) the level of utilization of the relatively fixed portions of the labor force; and (3) a lagged adjustment process of employment to short-run movements in production reflecting imperfect foresight, partial adjustment to temporary output swings, and costs of hiring or firing. These conclusions can be expressed in the following equations for unit labor costs and productivity:

$$(12) \quad ULC = w \frac{L(x)}{x};$$

$$(13) \quad \frac{x}{L(x)} = a_1 \left[ \frac{x}{x_K} \right]^{a_2} \left[ \frac{x/x_K}{(x/x_K)_{-1}} \right]^{a_3} e^{a_4 t}$$

Therefore

$$(14) \quad ULC = \frac{w}{a_1 \left[ \frac{x}{x_K} \right]^{a_2} \left[ \frac{x/x_K}{(x/x_K)_{-1}} \right]^{a_3} e^{a_4 t}}$$

This equation was fitted in logarithmic form to seasonally adjusted data for all manufacturing and for durables and nondurables (see Table 1). While these equations raise some questions for further study, they are of sufficient statistical quality to serve for their specific purpose here.<sup>11</sup>

Estimates for standard unit labor costs can be derived from the above

<sup>10</sup> Professor Klein kindly made these corrections available for all manufacturing. We disaggregated the adjustment for durable and nondurable manufacturing.

<sup>11</sup> Because we use average hourly earnings rather than total compensation per manhour as our wage rate variable, the coefficient on wages was not constrained to equal one. An elasticity greater than one is to be expected since average hourly earnings are smaller and less volatile than total compensation. Nonetheless, the coefficient for durables is uncomfortably large and may be serving as a proxy for other cost factors.

According to this formulation, the adjustment process occurs in one quarter, rather than the distributed lag form of the productivity studies. But additional lags are not significant in the unit labor cost equations.

In nondurable manufacturing

$$\frac{x/x_K}{(x/x_K)_{-1}}$$

is not significant, suggesting that the adjustment process is a lesser factor in that sector. Michael D. McCarthy has fitted similar equations derived from a complete production function. The resultant equations are rather similar to ours. Our price equations are affected very little by substituting labor cost estimates of  $ULC^N$  based on McCarthy's functions rather than those of Table 1.

TABLE 1—EQUATIONS FOR UNIT LABOR COSTS\*  
(1953:3 to 1965:4)

## All Manufacturing

$$\ln ULC = -1.286 + 1.995 \ln AHE - 0.0140 - 0.361 \ln x/x_K - 0.198 \ln \left[ \frac{x}{(x/x_K)_{-1}} \right]$$

(19.38)            (-15.85)   (-13.90)            (-4.42)

## Durable Manufacturing

$$\ln ULC = -1.590 + 2.402 \ln AHE - 0.0167 - 0.306 \ln x/x_K - 0.284 \ln \left[ \frac{x/x_K}{(x/x_K)_{-1}} \right]$$

(15.36)            (-12.50)(-10.01)            (-5.54)             $R^2 = 0.962$   
 $D.W. = 0.81$

## Nondurable Manufacturing

$$\ln ULC = -0.867 + 1.136 \ln AHE - 0.0077 - 0.422 \ln x/x_K$$

(17.52)            (-14.03)(-13.07)             $R^2 = 0.972$   
 $D.W. = 1.30$

\*  $t$ -statistic in parentheses;  $R^2$  = coefficient of determination adjusted for degrees of freedom;  $D.W.$  = Durbin-Watson statistic.

equations by setting  $[x/x_K]$  equal to a constant standard value, and

$$\left[ \frac{x/x_K}{(x/x_K)_{-1}} \right]$$

equal to one.

Then

$$(15) \quad ULC^N = a_5 \frac{w}{e^{at}}$$

Evaluating  $ULC^N$  for each period yields the standard unit labor cost estimates employed in our price equations;  $ULC^N$  is affected only by changes in average hourly earnings and the time trend.

*Deviation of Actual from Standard Unit Labor Cost:* Both standard and actual unit labor costs may influence prices. To test for the independent effect of  $ULC$ , its deviation from  $ULC^N$  is introduced. Under oligopoly pricing there should be no price impact of  $ULC - ULC^N$ ; under the supply-demand competitive pricing method, actual unit labor costs should yield superior price equations to those relying on standard unit labor costs. Under a mixed system, both  $ULC^N$  and  $(ULC - ULC^N)$  should appear in the equations, but with different coefficients.

*The Target Return on Capital:* In the absence of sufficient direct evidence on target rates of return, two approaches can be taken to the statistical testing of this component of the oligopoly theory of pricing. First, one can attempt to estimate a time series for the ratio of capital to standard output, and let the regression estimate the target ratio. However, the available time series on capital are not sufficiently precise to reveal the inevitably small quarterly changes in this ratio, and so this

approach could not be used. As an alternative, the response of price to the profit rate on capital can be taken as a reflection of target-return pricing; a particularly low (therefore probably below-target) rate of profit at normal operating rates may call for a price increase, i.e., there should be a negative relationship between profits and price change. Since the simple correlation between price change and the profit rate is positive, of course, identification of this factor requires that cost and demand factors be measured rather precisely by the other explanatory variables in the equations. The profit rate employed in this study is the after-tax rate of return on real capital (as estimated by the Office of Business Economics) corrected by the operating rate.

### *Forms of the Equation*

The equations are fitted to quarterly levels of the price indexes, to quarterly first differences, and to per cent changes for overlapping four-quarter intervals. Equations for price levels are vulnerable to multicollinearity introduced by common time trends, and are uncomfortably close to the identity of value, that is, price equals the sum of unit costs and unit profits. One-quarter differences show less of these difficulties, but given the small changes in the variables which occur from one quarter to the next, the errors of measurement are large compared to the actual price movements. Indeed, since the indexes are quoted to the nearest tenth of a point, rounding alone loses considerable quarterly variation. The four-quarter differences are a good compromise in these regards, but suffer from the autocorrelation induced by overlapping data. We analyze the results for all three kinds of equations.

As a further check on the structure of the equations and particularly of the dynamic processes, the equations have also been fitted with the dependent variable lagged by one interval. These equations can be interpreted as the result of a Koyck transformation, assuming exponentially declining weights on the lag coefficients, with the regression coefficient on the lagged dependent variable indicating the speed of adjustment.

### *Period of Analysis*

The period 1954:1 to 1965:4 was used to fit the equations; 1966 and 1967 were used as tests of stability of the coefficients. If the Korean War is included, the results are dominated by a few extreme observations. Although the results look stronger statistically, one cannot identify the price equation from the data for that period. Our equation assumes that cost- and demand-pressures act on manufacturing prices, and that the feedback through consumer prices to wages is weak, and delayed through the wage-round phenomenon. During the Korean War the feedbacks became much quicker, and the level of excess demand became so great that

expectational factors and nonlinearities became important; these were not felt to the same degree in more normal periods.

### *Results*

The equations generally correspond to economists' a priori expectations. Cost- and demand-elements "explain" price levels; even in the one-quarter and four-quarter difference equations, they explain a large fraction of the total variance. The adjustment processes appear to be short, with much of the adjustment coming within three months, most of it within six months. While the different forms of the equations yield varying results on the relative importance of the competitive mechanism vis-à-vis oligopolistic pricing, there is pretty strong evidence that equations combining both mechanisms are superior to equations using either approach in isolation. Tests for asymmetries in pricing showed some evidence in support of the proposition that prices have a greater tendency to increase than to fall. Only small bits of evidence could be found to distinguish the target-return from the full-cost pricing methods. While the equations for all manufacturing, durables, and non-durables are similar in their overall structure, equations for all manufacturing and durables were of higher statistical quality and yielded more conclusive results. A more detailed discussion of the results follows.

### *All Manufacturing*

*Price Levels.* Equations for the levels of prices (see Table 2) show the expected heavy weight attributed to cost factors. Standard unit labor costs in the current and preceding quarters have larger  $b$  and  $\beta$  coefficients than the deviation between actual and standard labor costs, giving some preliminary support to the target-return hypothesis as a part of the pricing process. Material prices are highly significant. Two demand factors, the operating rate and the change in the ratio of unfilled orders to sales, are also significant, but, viewed in terms of beta coefficients, carry a smaller part of the explanation. Autocorrelation is very high, suggesting some misspecification. The coefficients on the cost variables are unrealistically large.

Conversion of the equation into dynamic form, with the dependent variable lagged one quarter, is more revealing (see equation (2-(2))). The coefficient of the lagged price is highly significant and equal to .79, suggesting that the current price level is the result of a series of distributed lag adjustments to earlier cost and demand pressures. The influence of demand variables becomes greater, and is about equal to the weight of cost factors in terms of beta coefficients. However, the lagged dependent variable carries two-thirds of the total explanation.

Although comparison of statistical significance is difficult with an

TABLE 2—REGRESSION RESULTS FOR PRICES: ALL MANUFACTURING

Equation	WPI	$\alpha$	ULC <sup>N</sup>	ULC <sup>N</sup> -1	ULC-ULC <sup>N</sup>	$\hat{p}_m$	$\pi/\pi_K$	$\Delta \left( \frac{O_u}{S} \right)_{-1}$	WPI-1	$\bar{R}^2$	$S_e$	D.W.
2-(1)		0.030	0.491 (3.62)	0.543 (4.29)	0.267 (2.73)	0.186 (3.82)	0.0010 (2.91)	0.326 (2.46)		0.982	0.0044	0.77
2-(2)		-0.097	0.212 (3.23)		0.167 (3.30)	0.080 (4.91)	0.0010 (5.94)	0.151 (2.58)	0.789 (13.22)	0.995	0.0023	1.59
2-(3)		-0.142	1.052 (26.14)			0.165 (3.38)	0.0030 (9.41)	0.108 (0.57)		0.952	0.0071	0.63
2-(4)		-0.108	0.179 (3.79)			0.079 (4.89)	0.0010 (7.40)	0.162 (2.70)	0.819 (19.16)	0.995	0.0022	1.64

QUARTERLY CHANGES												
Equation	$\Delta$ WPI	$\alpha$	$\Delta$ ULC <sup>N</sup>	$\Delta$ ULC <sup>N</sup> -1	$\Delta$ (ULC-ULC <sup>N</sup> )	$\Delta \hat{p}_m$	$\pi/\pi_K$	$\Delta \left( \frac{O_u}{S} \right)_{-1}$	$\Delta$ WPI-1	$\bar{R}^2$	$S_e$	D.W.
2-(5)		-0.025	0.235 (2.70)	0.155 (2.52)	0.085 (2.11)	0.065 (2.98)	0.0003 (3.08)	0.141 (2.21)		0.654	0.0024	1.62
2-(6)		-0.015	0.200 (2.39)	0.133 (2.26)	(1.12)	0.062 (2.95)	0.0002 (1.79)	0.154 (2.53)	0.274 (2.35)	0.690	0.0023	2.15
2-(7)		-0.041	$\Delta$ ULC (1.69)			0.072 (3.00)	0.0005 (5.72)	0.127 (2.00)		0.583	0.0026	1.29
2-(8)		-0.029	0.022 (0.51)			0.068 (3.00)	0.0004 (3.45)	0.152 (2.49)	0.304 (2.41)	0.627	0.0025	1.87

FOUR QUARTER PER CENT CHANGES												
Equation	$\frac{WPI - WPI_{-4}}{WPI_{-4}}$	$\alpha$	$\frac{ULC^N ULC^N_{-4}}{ULC^N_{-4}}$	$\left[ \left( \frac{ULC - ULC^N}{ULC^N} \right) - \left( \frac{ULC - ULC^N}{ULC^N} \right)_{-4} \right]$	$\frac{\hat{p}_m - \hat{p}_{m-4}}{\hat{p}_{m-4}}$	$\frac{1}{4} \sum_{t=0}^3 \pi/\pi_K$	$\frac{1}{4} \sum_{t=0}^3 \left( \frac{O_u}{S} \right)_{-1}$	$\bar{R}^2$	$S_e$	D.W.		
2-(9)		-0.124	0.350 (6.84)	0.043 (1.43)	0.071 (3.17)	0.0015 (5.34)	0.042 (1.43)		0.892	0.0045	1.01	
2-(10)		-0.194	$\frac{ULC - ULC_{-4}}{ULC_{-4}}$		0.054 (1.50)	0.0024 (6.07)	$\frac{1}{4} \sum_{t=0}^3 \left( \frac{O_u}{S} \right)_{-1}$		0.707	0.0075	0.41	

Note  $S_e$  = standard error of estimate.

equation which includes the dependent variable in lagged form, we note that the  $\bar{R}^2$  becomes very high and the standard error of estimate substantially smaller. But, of course, it is not satisfactory to rest so much of the statistical explanation on the lagged dependent variable. The task is to identify the mechanism explicitly. These considerations suggest that the equation can be better identified from the analysis of price changes. Price levels appear to be the result of preceding price changes.

*Quarterly Changes.* Equations for quarterly changes are more powerful analytically even though the  $\bar{R}^2$ s are much lower of course. The standard errors of estimate are smaller, autocorrelation disappears, and the explanation no longer rests heavily on the lagged dependent variable. Changes in standard unit labor costs strongly influence prices, the coefficient of  $\Delta ULC^N$  is substantially greater than that of  $\Delta(ULC - ULC^N)$ . Changes in material prices and the demand variables,  $x/x_K$  and  $\Delta(O_w/S)_{-1}$ , are highly significant. The sum of the beta coefficients of the cost variables slightly exceeds the sum for the demand variables (equation 2-(5)).

The low coefficient on lagged price suggests that the lags in the other variables,  $\Delta ULC^N_{-1}$  and  $\Delta(O_w/S)_{-1}$ , account for most of the dynamics in the process. Thus this equation argues that prices adjust rather promptly to changes in demand and cost conditions, with the largest part of the adjustment occurring within a few months.

Comparison of equations 2-(5) and 2-(7) shows that the combined target-return and supply-demand equation provides a better statistical explanation than a purely competitive formulation.  $\Delta ULC$ , if used alone, is not statistically significant, while the combination of  $\Delta ULC^N$  and  $\Delta(ULC - ULC^N)$  makes all the cost coefficients significant (again with larger coefficients on the standard cost concept). The simple correlation between  $\Delta p$  and  $\Delta ULC$  is close to zero because the large productivity gains during rapid economic advance offset other cost factors. The standard unit labor cost variable has sorted this element out of the equation, thereby letting the demand and cost factors play their proper economic role.<sup>12</sup>

*Per Cent Changes over Four Quarters.* Equations for the overlapping four-quarter price changes generally confirm the quarterly results, except that unfilled orders play a lesser role. Equations using only  $ULC$  as the labor cost measure are clearly inferior.  $ULC$  takes on the wrong sign

<sup>12</sup> Stanley Black suggested that  $ULC^N$  should be corrected for changes in the industrial composition of employment. The equation for  $ULC$  was reestimated using the official mix-corrected series for  $AHE$ , and the resultant estimates for  $ULC^N$  were used in refitting (2-5). The results were affected as follows:  $\bar{R}^2$  rose from .65 to .72; the coefficient on  $ULC^N_{-1}$  rose substantially and on  $\Delta(ULC - ULC^N)$  fell to a small, negative, insignificant value. Operating rates became more significant, orders less so. The coefficient on the preceding price change fell to .05

and is not significant;  $\bar{R}^2$  is substantially lower, and autocorrelation is severe. If the dependent variable is added in lagged form, it is not significant and has a very small coefficient, again suggesting that the adjustment process occurs within the four quarters. Because of the overlapping of the data, autocorrelation of the error terms is introduced. The standard error of estimate is larger than in the quarterly equations despite the higher  $\bar{R}^2$ , and since this form of the equation uses only one quarter of new data for each successive observation, it must be considered inferior to the quarterly form. These results suggest that despite the difficulties quarterly first differences are the preferred form of analysis for price equations.

### *Results for Durable Manufacturing*

Results for durables are generally similar in coefficients, statistical significance, and theoretical implication. (See Table 3.) Coefficients for standard unit labor costs are relatively larger, and equations using only actual unit labor costs are worse.

There is one intriguing novelty in these equations to which we would not wish to attach excessive weight. The profit rate ( $\pi$ ) is statistically significant and has a negative sign (equation 3-(5)), which is evidence in support of the target-return pricing hypothesis. This variable appears even more strongly in the four-quarter form of the equation.

### *Results for Nondurable Manufacturing*

The equations for prices of nondurables "explain" a large part of the variation of nondurable prices, but show little distinction among competing price hypotheses (Table 4). Fewer variables were significant and  $\bar{R}^2$ 's were lower. Raw material prices have larger coefficients, reflecting particularly the effects of volatile agricultural prices for foodstuffs and fibers. Substituting actual for standard unit labor costs leads to only small changes in the equations. Since the nondurable industries are less concentrated, one would expect less influence of full cost and target-return pricing. Further, the operating rates were more stable in this sector, and so the differences between  $ULC$  and  $ULC^N$  were small.

and became insignificant, suggesting that the lags of the adjustment process are very short. The resultant equation is

$$2-(5)' \Delta WPI = -0.03 + 0.259\Delta ULC^N + 0.289\Delta ULC_{-1}^N + 0.050\Delta p_m + 0.0004x \\
\begin{matrix} (2.71) & (3.08) & (2.60) & (5.20)x_K \\ + 0.077\Delta \left( \frac{O_s}{s} \right) \\ (1.65) \end{matrix}$$

$$\bar{R}^2 = 0.717; DW = 1.87$$

TABLE 3—REGRESSION RESULTS FOR PRICES: DURABLE MANUFACTURES

LEVELS									
Equation	WPI	$\alpha$	$ULC^N$	$ULC^N_{-1}$	$ULC-ULC^N$	$\hat{p}_m$	$\pi/\pi_K$	$\Delta\left(\frac{O_u}{S}\right)_{-1}$	$R^2$ $S_e$ D.W.
3-(1)		-0.060	0.770 (6.08)	0.450 (3.99)	0.387 (3.73)	0.116 (1.92)	0.0010 (2.34)	0.164 (2.35)	0.985 0.0063 0.63
3-(2)		-0.907	0.910 (4.45)	0.381 (1.96)		-0.157 (-2.16)	0.0041 (5.05)	-0.045 (-0.43)	0.965 0.0091 0.73
QUARTERLY CHANGES									
Equation	$\Delta WPI$	$\alpha$	$\Delta ULC^N$	$\Delta ULC^N_{-1}$	$\Delta(ULC-ULC^N)$	$\Delta \hat{p}_m$	$\Delta \hat{p}_{m-1}$	$\pi/\pi_K$ $\Delta\left(\frac{O_u}{S}\right)_{-1}$	$R^2$ $S_e$ D.W.
3-(3)		-0.0165	0.367 (4.14)	0.123 (2.46)	0.142 (3.41)	0.142 (3.17)	0.078 (1.58)	0.0002 (2.23)	0.627 0.0033 1.66
3-(4)		-0.0089	0.129 (2.78)	0.189 (1.88)		0.074 (1.62)		0.0001 (1.27)	0.678 0.0031 2.26
3-(5)		-0.0202	0.243 (2.61)	0.118 (2.06)	0.113 (2.82)	0.114 (2.44)	0.068 (1.45)	0.0004 (3.36)	0.678 0.0031 1.63
3-(6)		-0.0314	0.069 (1.66)			0.105 (1.79)	0.097 (1.63)	0.0004 (3.96)	0.474 0.0039 0.99
3-(7)		-0.0166	-0.038 (-0.97)			0.056 (1.13)		0.0002 (2.10)	0.608 0.0034 2.11
FOUR QUARTERS PER CENT CHANGES									
Equation	$\frac{WPI-WPI_{-4}}{WPI_{-4}}$	$\alpha$	$\frac{ULC^N-ULC^N_{-4}}{ULC^N_{-4}}$	$\left[\frac{(ULC-ULC^N)}{ULC^N}-\frac{(ULC-ULC^N)}{ULC^N_{-4}}\right]$	$\frac{\hat{p}_m-\hat{p}_{m-4}}{\hat{p}_{m-4}}$	$\frac{1}{4}\frac{\sum_{i=0}^3 \pi/\pi_K}{\pi/\pi_K}$	$\frac{1}{4}\frac{\sum_{i=0}^3 \pi/\pi_K}{\pi/\pi_K}$	$\frac{1}{4}\frac{\sum_{i=0}^3 \Delta\left(\frac{O_u}{S}\right)}{\Delta\left(\frac{O_u}{S}\right)}$	$R^2$ $S_e$ D.W.
3-(8)		-0.0632	0.480 (8.42)		0.154 (3.08)	0.262 (6.07)	0.0007 (2.49)	0.055 (2.04)	0.907 0.0064 0.99
3-(9)		-0.0904	$\frac{ULC_{-4}}{ULC_{-4}}$ (2.80)		0.391 (6.35)	0.0008 (1.79)		0.153 (4.13)	0.774 0.0100 0.52



TABLE 4—REGRESSION RESULTS FOR PRICES: NONDURABLE MANUFACTURING

LEVELS

Equation	$WPI$	$\alpha$	$ULCN$	$p_m$	$\pi/\pi_K$	$WPI_{-1}$	$\bar{R}^2$	$S_e$	$D.W.$
4(1)		0.284	0.683 (12.66)	0.235 (6.43)	0.0005 (1.10)		0.888	0.0055	0.57
4(2)		-0.025	0.287 (3.56)	0.113 (3.21)	0.0009 (2.73)	0.648 (5.67)	0.936	0.0041	1.15
4(3)		0.076	$ULC$ (12.08)	0.270 (7.28)	0.0025 (5.24)		0.879	0.0057	0.56
4(4)		-0.121	0.263 (3.41)	0.122 (3.31)	0.0017 (4.57)	0.674 (6.03)	0.934	0.0042	1.15

QUARTERLY										
Equation	$\Delta WPI$	$\alpha$	$\Delta ULCN_{-1}$	$\Delta p_m$	$\Delta p_{m-1}$	$\pi/\pi_K$	$\Delta \left( \frac{O_u}{S} \right)_{-1}$	$\bar{R}^2$	$S_e$	$D.W.$
4(5)		-0.053	0.116 (0.43)	0.180 (5.60)	0.062 (1.82)	0.0006 (2.27)		0.482	0.0036	2.06
4(6)		-0.055	$\Delta ULC$ (1.30)	0.179 (5.48)	0.069 (1.97)	0.0006 (2.69)	0.129 (0.25)	0.488	0.0035	2.03

FOUR QUARTERS									
Equation	$\frac{WPI - WPI_{-4}}{WPI_{-4}}$	$\alpha$	$\frac{ULCN - ULCN_{-4}}{ULCN_{-4}}$	$\frac{p_m - p_{m-4}}{p_{m-4}}$			$\bar{R}^2$	$S_e$	$D.W.$
4(7)		-0.001	0.353 (3.91)	0.262 (9.00)			0.724	0.0067	0.73
4(8)		-0.003	$ULC - ULC_{-4}$ $ULC_{-4}$ (3.05)	0.240 (7.02)			0.693	0.0070	0.62

*Asymmetries in Pricing?*

Slichter stressed that prices tended to rise in good times but failed to fall during slack periods. Schultze [19] [20] has added that prices rise in the more prosperous industries but fail to fall concurrently in the less prosperous.

Two tests for asymmetry were performed: First  $ULC-ULC^N$  was separated into two variables depending on the sign. (See Table 5.) In the case of the equations for manufacturing price levels, the coefficient on the plusses was larger. The quarterly equations for durables show stronger evidence of the postulated asymmetry, but other equations show very mixed results. Thus this form of test does not indicate strong asymmetries.

A second test is a two-step procedure in which the quarterly price equation is fitted, and those quarters in which prices should have fallen according to the equation are identified. The equation is then reestimated for those quarters in which prices should have risen (equation 5-(4)). The resultant coefficients on costs are greater than in the comparable equation fitted to all quarters (equation 2-(5)), suggesting a bigger than average price response to cost increases. (The equation could not be fitted separately to quarters of estimated price decreases because there were too few of them.) While there is some evidence here of asymmetry, it appears to be a minor quantitative element. It should be recalled, however, that the influence of  $ULC^N$  already contains a major element of downward price rigidity since it precludes any price effect from cyclical labor cost declines.

*Relative Significance of Different Demand Variables*

Of the several demand variables, the industrial operating rate consistently accounts for the largest fraction of the variance and has the greatest statistical significance. For example, its beta weight is .36 in equation 2-(5), compared to .23 for the change in the order backlog. Inventory disequilibrium, results for which are not reported separately here, is statistically significant in some of the equations if the operating rate is excluded. Multicollinearity between these two variables causes inventory disequilibrium to become insignificant, and sometimes to take on the wrong sign, when included in the equation with the operating rate. Thus while our conclusion is not necessarily inconsistent with the findings of Schultze [20] and Liu [14] who found greater significance for this factor, we cannot find an effect independent of the operating rate.

It is surprising that the operating rate, which reflects the relation between production and capacity, plays a greater quantitative role than the direct measures of supply-demand disequilibrium. The disequilibria may be so transitory in many markets that quarterly statistics do not

TABLE 5—TESTS FOR ASYMMETRIES IN PRICING

ALL MANUFACTURING—LEVELS									
Equation	WPI	$\alpha$	$ULC^N$	$(+)[ULC-ULC^N]$	$(-)[ULC-ULC^N]$	$\hat{\rho}_m$	$\pi/\pi_K$	$\Delta\left(\frac{O_h}{S}\right)^{-1}$	D.W.
5-(1)		-0.091	0.215 (3.30)	0.194 (3.51)	0.106 (1.47)	0.073 (4.23)	0.001 (5.72)	0.140 (2.24)	1.56
ALL MANUFACTURING—QUARTERLY									
Equation	$\Delta WPI$	$\alpha$	$\Delta ULC^N$	$\Delta ULC^{N-1}$	$\Delta(ULC-ULC^N)$ (+)	$\Delta(ULC-ULC^N)$ (-)	$\Delta \hat{\rho}_m$	$\pi/\pi_K$	D.W.
5-(2)		-0.024	0.242 (2.68)	0.159 (2.51)	0.073 (1.34)	0.103 (1.54)	0.065 (2.91)	0.0003 (2.80)	1.61
DURABLE MANUFACTURING—QUARTERLY									
Equation	$\Delta WPI$	$\alpha$	$\Delta ULC^N$	$\Delta ULC^{N-1}$	$\Delta(ULC-ULC^N)$ (+)	$\Delta(ULC-ULC^N)$ (-)	$\Delta \hat{\rho}_m$	$\pi/\pi_K$	D.W.
5-(3)		-0.002	0.339 (3.02)	0.144 (2.23)	0.150 (2.93)	0.097 (1.58)	0.108 (2.16)	0.0003 (2.94)	1.57
ALL MANUFACTURING—QUARTERLY; QUARTERS WITH ESTIMATED PRICE DECLINE OMITTED <sup>a</sup>									
Equation	$\Delta WPI$	$\alpha$	$\Delta ULC^N$	$\Delta ULC^{N-1}$	$\Delta(ULC-ULC^N)$	$\Delta \hat{\rho}_m$	$\pi/\pi_K$	$\Delta\left(\frac{O_h}{S}\right)^{-1}$	D.W.
5-(4)		-0.037	0.234 (2.81)	0.184 (2.52)	0.104 (2.49)	0.068 (2.86)	0.00045 (4.12)	0.171 (2.43)	2.04

<sup>a</sup> Omitted quarters: 3-54; 4-54; 2-58; 3-58; 4-59; 3-60; 1-61; 2-61; 2-62. This equation should be compared with 2-5.

reflect them fully. Also, price change appears to be a "coincident" and perhaps even a slightly "lagging" indicator of the business cycle. The excess-demand measures are "leading" indicators, and thus even though they may presage price changes, their immediate mechanical correlation with price changes may be weaker, even after a crude estimation of lags, than direct correlations among coincident indicators. Finally, the list prices which compose our dependent variable may themselves lag slightly after the transactions prices; if transactions prices could actually be identified they might correlate more closely with the excess demand measures.

#### *IV. Comparison to Previous Results*

The present study may be compared to the results of earlier investigations using generally similar techniques. Most of the early studies explained price levels. Wilson [22] was the first to relate price changes to changes in unfilled orders and wage rates in his study of machinery industries. Although he does not offer a detailed micro-economic foundation for his equation, the wage rate variable can be interpreted as a proxy for standard unit labor costs, with the productivity trend reflected in the constant. Fromm [9] employed standard unit labor costs in price equations. Zarnowitz [25] analyzed orders and price changes as alternative adjustments to excess demand. Yordon [24] showed the impact of cost changes in various types of industries. Perry [16] and Schultze [20] [21] found that standard unit labor costs, deviations of actual from standard labor costs, material prices, operating rates and inventory disequilibria were significant variables, and also found some evidence of asymmetry. Schultze's estimation period includes the Korean War, resulting in somewhat different coefficients. Our study clearly builds on his findings, adding orders to the demand variables, using a more fully developed standard unit labor cost theory, and providing a more explicit set of pricing hypotheses, including target-return pricing.

Neild's analysis [15] of British data corresponds with our findings in that standard labor costs are highly significant in contrast to actual labor costs. But Neild finds less influence for short-run demand factors. This can be explained by his use of equations in the price level form which give a heavier weight to cost elements because of their common trend values. Also he measures demand by an index of excess demand for the labor market, the Dicks-Mireaux index. If order figures, operating rates, or other evidence of demand pressures in product markets had been used, his regressions might have shown more evidence of short-run demand influences on pricing.<sup>13</sup>

<sup>13</sup> Rushdy and Lund [17] have shown that Neild's data show greater influence for demand variables if used in quarterly-change form.

### V. Recent Inflation and Price Stability as Seen Through the Equations

Price equations can be used to analyze recent history. Movements in the cost and demand factors combined to produce the price record. Using 2-(5) the quarterly equation without a lagged dependent variable, shows how these forces added up (See Table 7). It also compares the estimates with the actual record, including seven recent quarters beyond the period of fit.

The period is divided into three intervals: the inflation of 1954:3 to 1957:3; price stability from 1957:4 to 1964:2, and the inflation since then. Of the total price rise of 8.2 per cent in the mid-fifties, increases in unit labor costs account for 2.7 per cent. The excess of operating rates

TABLE 6—MEANS AND STANDARD DEVIATIONS OF VARIABLES USED IN PRICE EQUATIONS

Variable	All Manufacturing		Durables		Nondurables	
	Means	Standard Deviations	Means	Standard Deviations	Means	Standard Deviations
<b>Levels</b>						
$WPI$	0.9912	0.0328	0.9925	0.0492	0.9898	0.0165
$ULC^N$	0.6768	0.0298	0.7066	0.0396	0.6361	0.0172
$ULC$	0.6778	0.0358	0.7081	0.0482	0.6360	0.0205
$ULC - ULC^N$	0.0011	0.0161	0.0015	0.0242	-0.0001	0.0076
$\hat{p}_m$	0.9715	0.0272	0.9830	0.0244	0.9737	0.0292
$\pi/x_K$	85.6485	4.7345	81.4966	6.4905	91.7564	2.3816
$\Delta \left[ \frac{O_u}{S} \right]_{-1}$	-0.0017	0.0066	-0.0028	0.0145	-0.0001	0.0012
<b>Quarterly</b>						
$\Delta WPI$	0.0026	0.0041	0.0040	0.0055	0.0011	0.0050
$\Delta ULC^N$	0.0021	0.0070	0.0027	0.0112	0.0012	0.0024
$\Delta ULC$	0.0018	0.0098	0.0024	0.0147	0.0009	0.0061
$\Delta (ULC - ULC^N)$	-0.0004	0.0137	-0.0003	0.0227	-0.0003	0.0060
$\Delta \hat{p}_m$	0.0005	0.0168	0.0016	0.0119	0.0008	0.0167
$\pi$			0.0026	0.0005		
<b>Four Quarters</b>						
$WPI - WPI_{-4}$	0.0105	0.0140	0.0169	0.0213	0.0040	0.0128
$ULC^N - ULC^N_{-4}$	0.0125	0.0224	0.0163	0.0294	0.0073	0.0114
$ULC - ULC_{-4}$	0.0118	0.0338	0.0154	0.0465	0.0064	0.0206
$ULC_{-4}$						
$\hat{p}_m - \hat{p}_{m-4}$	-0.0011	0.0341	0.0062	0.0279	0.0004	0.0353
$\frac{1}{4} \sum_{i=1}^4 \left[ \frac{O_u}{S} \right]_{-i}$	0.1514	0.0323	0.2735	0.0517	0.0182	0.0031

TABLE 7—ANALYSIS OF RECENT PRICE HISTORY: CONTRIBUTIONS OF  
COST AND DEMAND VARIABLES (EQUATION 2-(5))  
(Percentage Points)

Period	Estimate $\Delta WPI$	Actual $\Delta WPI$	$\Delta ULC^N$	$\Delta ULC^N_{-1}$	$\Delta(ULC^N - ULC^N_{-1})$	$\Delta p_m$	Con- stant $+x/x_K$	$\Delta\left(\frac{O_x}{S}\right)_{-1}$
55.1-57.3	7.340	8.200	1.821	1.088	-0.179	0.404	4.168	0.043
57.4-64.2	2.410	1.500	0.443	0.425	0.061	-0.502	2.990	-0.981
64.3-67.3	6.550	5.600	0.996	0.492	0.052	0.442	4.149	0.457

over their price equilibrium level (see below) accounts for 4.2<sup>7</sup> per cent. The rest is mainly the unexplained residual, the equations underpredicting the total inflation by 0.9 per cent. Orders and materials prices added only fractions to the price rise.

During the seven years of virtual price stability, when prices rose only 2.4 per cent, labor costs rose only 0.9 per cent, while orders and material prices dampened price increases by 1.5 per cent. Despite the persistent slack in the economy, with operating rates far below normal, the net contribution of operating rates and the constant is positive by 3.0 per cent.

The equation overpredicts the opening seven quarters of the recent inflation by 1.0 per cent, an estimate of 6.6 per cent versus an actual price rise of 5.6 per cent. This overestimate can be interpreted as an improvement of the price component of the Phillips curve mechanism, thanks to guideposts and other factors. But clearly this is very limited, early evidence, and it appears that the record of 1968 is worse.

### VI. *Equilibrium Values for Price Stability*

From a policy point of view, perhaps the most disturbing result of this study is the equilibrium solution implicit in our equation. Suppose labor costs and material prices are stable, and the backlog of unfilled orders rises only with sales. What industrial operating rate would leave prices stable, given the constant in the equation? Using equation 2-(5),  $x/x_K = 82$  per cent is the equilibrium solution. The standard error of this estimate is considerable, however, and different forms of the equation yield varying equilibrium values. The Klein-Summers indexes average more than 2 points higher than the more widely reported indexes of the Federal Reserve Board, so that the equilibrium solution implies an FRB utilization rate below 80. According to the equation, which contains  $x/x_K$  in linear form, every additional point of the operating rate raises prices by .03 per cent a quarter. Higher utilization (say, 10 points better), all other factors assumed (unrealistically) to remain stable, raises prices by .3 per cent a quarter, or 1.2 per cent a year.

This is not a full measure of the inflationary bias in our industrial price-setting mechanism, of course. On the one hand, the prices produce a profit rate which leads to above-productivity wage increases, and hence to rises in  $ULC^N$ . On the other hand, the equation did overpredict the first seven quarters of the current inflation by 0.9 per cent, so perhaps the equilibrium values are somewhat better than they were in the mid-fifties.

Our equations imply a strategic importance for a relatively large capital stock in limiting an inflationary process. If full employment is achieved with a modest operating rate, say 86 per cent, price increases will be smaller than if it coincides with high operating rates. More modest price increases, in turn, yield lower profits, which dampen wage increases. This factor is of importance in assessing the long-term average Phillips curve of the economy.

The present paper reports on price equations at a rather high level of aggregation. The impact of market structure on pricing and the resultant extent of inflationary bias should be seen more clearly when equations are fitted at a finer level of detail.

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# AN ECONOMETRIC MODEL OF SOCIO-ECONOMIC AND POLITICAL CHANGE IN UNDERDEVELOPED COUNTRIES

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In this paper, we attempt to build an integrated econometric model of socio-economic and political change in underdeveloped countries. The purpose of the model is to obtain a statistical explanation of the economic and noneconomic forces which directly and indirectly determine a country's capacity for economic growth. The model is constructed by means of a step-wise regression analysis and is based upon data which summarize the economic, social, and political characteristics of 74 underdeveloped noncommunist nations during the period 1957-62. The model consists of 14 equations in 19 variables.

Once constructed, the model is used to explore the following questions: what forces appear to be quantitatively most important in determining a country's development prospects? What are the mechanisms by which the impact of these forces is felt? Answers to these questions, as economists will recognize, involve an evaluation of the overall multipliers of the economic, social, and political variables appearing in the model.

It may not come as a surprise to development specialists that, when the multipliers calculated from the model are ranked in order of importance, the majority of the ones above the median are noneconomic in nature. Indeed, of the ten multipliers that exceed .80, only four are purely economic; of the remaining six, five are social or socio-economic and one political.

The philosophy underlying the procedure used for constructing the model is quite overtly empiricist. Since there are no firmly validated theories of the process of socio-economic and political change, we consciously avoided a priori specification of the functions we wished to fit. Instead, we let the data specify the model. For this purpose the method of step-wise regression provides an economical way of choosing from a large set of variables that small subset most closely associated with any given dependent variable. The primary advantage of the method is that it provides an efficient and systematic way of selecting from all possible interactions those which are most statistically significant. The primary

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disadvantage, which it shares with any approach not grounded in theory, is that the particular subset of variables selected from the larger set may be a proxy for underlying forces rather than of importance in and of itself. In addition, as in ordinary regression analysis, one cannot deduce from any given association expressed in a regression equation that causality runs from the independent variable to the dependent variable rather than the other way around. To avoid this latter disadvantage, variables were omitted from equations in which their inclusion would lead to a clear-cut violation of the direction-of-causality constraint which must be obeyed by structural equations in a model. However, in view of the general state of ignorance in this area of economic research, this criterion for the omission of variables was used quite sparingly. In particular, variables were left in if their associations in given equations were the result of mutual interaction rather than by virtue of unidirectional causality.

In making intelligent use of an empiricist approach, one reverses the stereotype of the ideal relationship between theory and data. The textbook approach to empirical work (which is becoming more common in the econometrics of the last few years) starts with a theoretical derivation of the empirical relationships; the theoretically based model is then confronted with the empirical data. If theory and fact mesh at this point, all is well and good. If they do not, either the theoretical model or the statistical specification or both are revised until agreement between the two is obtained. In contrast, the empiricist approach, when properly used, starts by seeking the empirical associations which are statistically most important. The results of the empirical analysis are then confronted with whatever is known about the underlying relationships. If no sensible explanation for the empirical results can be given, then constraints are imposed upon the empirical specification. Examples of such constraints are the setting of certain intercorrelations to zero or the imposition of a positive or negative sign for particular regression coefficients. The empirical analysis is then repeated and the process continued until theoretical sense can be made of the results. In practice, therefore, the procedures followed by the intelligent empiricist and the ideal-type econometrician tend to converge. The choice of starting point, which constitutes the essential difference between the two approaches, is governed in large measure by the extent to which the theoretical foundations of the analysis are well formulated. In the present contest, enough is known to be able to discard "nonsense relationships" or to specify signs of interactions. However, the body of commonly held hypotheses concerning the process by which many social and political characteristics are determined is too small to use theory as a starting point for an empirical investigation.

### I. Data

The data used for the current model are from a study by the present authors of the interaction between economic and noneconomic influences upon the process of economic growth. These data reflect the characteristics of 74 underdeveloped noncommunist nations, and apply generally to the period 1957-1962.<sup>1</sup> They consist of 39 indicators of economic, social, and political aspects of national development that have been defined using both statistical and qualitative information. A list of these variables together with short definitions are given in Appendix A to the present paper; full descriptions of the definitional schemes together with the individual country classifications and the matrix of intercorrelations among the variables may be found in *Society, Politics and Economic Development: A Quantitative Approach*.<sup>2</sup>

### II. The Construction of the Model

In most macroeconomic models, the focus of the analysis is on the level or rate of growth of per capita GNP. However, since our present concern is with prospects for sustained economic growth, changes in per capita GNP do not provide a suitable focus; their inadequacy as a measure of the extent of movement toward capacity for self-sustained growth is strikingly evident from the many cases of "growth without development." Indeed, there is no natural indicator upon which to "hang" a model designed to explain potential for economic development. Consequently, it was necessary to construct a dependent variable which would provide the appropriate focus for the model. For this purpose, we explored the forces affecting a country's prospects for development by means of discriminant analysis.<sup>3</sup> In the discriminant study, we found that four socio-economic and political characteristics proved sufficient to distinguish reliably among three groups of countries that had been classified according to their overall development potential. It is the discriminant function consisting of a linear combination of these variables that provides the starting point for the current investigation.

To construct the present model, stepwise regression was used, first of all, to select from the full range of data those indices which best explained the four economic and noneconomic characteristics selected by the original discriminant analysis. The model was then expanded to provide statistical functions for the additional variables appearing in the four regression equations which emerged. As new variables entered

<sup>1</sup> Only the dynamic indicators are based upon a longer period; they measure the extent of improvement in performance between 1950 and 1963.

<sup>2</sup> Irma Adelman and C. T. Morris (Baltimore: Johns Hopkins Press, 1967).

<sup>3</sup> Irma Adelman and C. T. Morris, "Performance Criteria for Evaluating Economic Development Potential—An Operational Approach," *Quart. Jour. Econ.*, May 1968, 82.

into these additional functions, the same method was applied to find statistical equations explaining their behavior. To keep the model manageable, several constraints were imposed. First, each function was limited to no more than three independent variables. Second, a distinction was made between endogenous and exogenous variables. Since in a model as broadly conceived as this one it is difficult to distinguish on a priori grounds between these two classes of variables, we adopted purely empirical definitions: a variable was defined as exogenous if, using the stepwise procedure, no relationship "explaining" it could be found which accounted for more than 50 per cent of its overall variance.<sup>4</sup> The model estimated using these procedures consists of 14 equations in 19 variables, of which five are exogenous.

To facilitate interpretation of the multipliers calculated from the model, the equations are presented in standardized form. That is, they are normalized so that each variable is measured in multiples of its standard deviation rather than in its original units. Each regression coefficient therefore indicates the change in the dependent variable measured in standard-deviation units associated with a unit-standard-deviation change in the relevant independent variable. Since standard deviations can be viewed as representing "typical" or "equally likely" changes in the given variables, standardized regression coefficients thus indicate the effect of approximately equiprobable changes in the variables in the model.<sup>5</sup>

### III. *The Relationships of the Model*

In the following discussion, the discriminant function which constitutes the starting point for the construction of the model is considered first. Next, the equations for the four variables appearing in the discriminant function are presented. The remaining nine equations in the model are then discussed in the order of an alphabetical listing of the dependent variables. After a brief consideration of the exogenous variables the discussion concludes with an examination of the causal structure of the model.

#### *The Discriminant Function*

The purpose of the discriminant analysis was to devise relatively objective criteria, based on past performance, for identifying underdeveloped countries with good development potential. In order to ob-

<sup>4</sup> A high percentage-variance-explained-criterion was chosen for the definition of exogenous variables because the stepwise procedure employed for the derivation of the regression functions tends to bias the results towards high  $R^2$ 's.

<sup>5</sup> For a discussion of this point see A. S. Goldberger, *Econometric Theory*, New York 1964, pp. 197-98.

tain an initial estimate of the discriminant function, 73 underdeveloped noncommunist countries were first classified into three groups according to their past economic performance. The top group consisted of countries which from 1950/51 to 1963/64 had experienced an average annual rate of growth of real per capita GNP of at least 2 per cent and which, in addition, ranked at least moderately high with respect to no less than five out of seven economic performance characteristics.<sup>6</sup> The lowest group included all those countries which from 1950/51 to 1963/64 had an average annual real rate of growth of per capita GNP of less than 1 per cent per year. The remaining countries were assigned to the intermediate group.

The technique used in deriving objective criteria for distinguishing between performance groups was that of stepwise discriminant analysis. This method determines statistically, by an analysis of variance, those linear combinations of country performance characteristics that best discriminate among various groups of countries. The sense in which the derived functions discriminate best among groups is that they represent those linear combinations of characteristics, each of which, *seriatim* (given the preceding variables), maximizes the remaining distance between the square of the difference between group means and the variance within groups. In selecting the variables for the discriminant function, the analysis at each step scans the entire list of variables not already in the discriminant function and then selects that variable which adds most to the explanation of the variance between group means, given the other variables already included. Variables are added to the discriminant function as long as they meet a preassigned level of statistical significance.

In our case, the discriminant analysis was performed with 29 variables representing a wide range of the social, political, and economic characteristics of low-income countries.<sup>7</sup> It is from these that the method chose the four traits that proved most reliable in classifying countries according to their potential for successful economic performance.

The discriminant function obtained in this manner consisted of a linear combination of the following variables (listed in the order of their statistical importance): (1) the degree of improvement in financial institutions ( $X_{18}$ ), (2) the degree of modernization of outlook ( $X_{31}$ ), (3) the extent of leadership commitment to economic development ( $X_{49}$ ),

<sup>6</sup> The seven characteristics considered are: the change in the degree of industrialization; the degrees of improvement in agricultural productivity, physical overhead capital, financial institutions, and the tax system; the gross investment rate; and the rate of additions to the stock of human resources.

<sup>7</sup> The variables describing the extent of democracy were deleted from the discriminant analysis since previous investigation had revealed that they were essentially irrelevant to short-run economic performance.

and (4) the degree of improvement in agricultural productivity ( $X_7$ ). In the notation of the present paper, the discriminant function is normalized so that the discriminant score has unit variance:

$$(1) \quad D = .95X_{13} + 1.39X_{31} + .88X_{49} + .70X_7.$$

As was discussed in our previous paper, the first of these variables, the degree of improvement in financial institutions, describes a fundamental aspect of successful economic performance in developing countries—the loosening through domestic efforts of the saving-investment constraint. The inclusion of the indicator of the degree of modernization of outlook reflects the much emphasized fact that the presence of attitudes favorable to change and innovation is a crucial factor in successful economic growth. The third variable, the extent of leadership commitment to economic development, also summarizes an important non-economic influence upon economic progress, one which is particularly critical in countries in which socio-structural bottlenecks to development have been overcome. The final variable in the discriminant function, the degree of improvement in agricultural productivity, expresses the crucial manner in which the elimination of bottlenecks in the agricultural sector increases growth potential. Thus, the four variables forming the starting point for the construction of our model summarize two economic and two noneconomic forces that encompass to a striking extent the full range of characteristics of low-income countries that could be expected to affect their development prospects.

### *Improvement in Financial Institutions*

The financial institutions of a developing country are frequently cited as an indispensable mechanism for increasing the proportion of total domestic resources saved and for channeling available internal saving effectively into productive investment.<sup>8</sup> It is thus appropriate that the variable representing financial improvements has an important role in the present model.

The regression function for the indicator of the degree of improvement in financial institutions, which accounts for 57 per cent of its overall variance, contains two variables: the change in the degree of industrialization ( $X_4$ ) and the extent of dualism ( $X_{21}$ ).<sup>9</sup>

$$(2) \quad X_{13} = .60X_4 + .33X_{21} \quad R^2 = .57$$

(6.33)    (4.46)

<sup>8</sup> For references to the literature on financial improvements and on the other aspects of national socio-economic and political development summarized by the variables in our model, see the relevant sections of Chapter II of *Society, Politics and Economic Development* by the present authors.

<sup>9</sup> The numbers in parentheses under the various coefficients are their respective t-ratios.

The first variable, the indicator of the change in the degree of industrialization reflects the positive impact on financial organization of the increases in the demand for credit that characteristically accompany the expansion of the industrial sector.

The inclusion of the indicator of the degree of dualism, the second variable in the financial equation, depicts the parallel importance for improving financial institutions of expansions in the demand for credit caused by the generalization of growth outside the urban-industrial complex.

Thus, in general, the equation for short-run financial development underlines the importance of positive changes in the demand of both industry and agriculture for credit in inducing better performance in the financial sector of underdeveloped countries.

### *Modernization of Outlook*

Basic to the entire process of a country's development from a traditional agrarian society into a modern market-oriented society, is a striking transformation of outlook and values. This modernization of outlook has many aspects including the evolution of the idea of individual participation in the larger society and the replacement of received ascriptive behavior standards by achievement-oriented norms.

In the present model, the degree of modernization of outlook is related to the extent of dualism ( $X_{21}$ ), the level of adequacy of physical overhead capital ( $X_8$ ), and (with a negative sign) the size of the traditional agricultural sector ( $X_5$ ).

$$(3) \quad X_{31} = .45X_{21} + .36X_8 - .09X_5 \quad R^2 = .72$$

(3.78)    (2.78)    (2.41)

The first variable, the extent of dualism, expresses the impact of the rise of the modern sector, the concomitant expansion of the market economy and the subsequent economic integration of the country in inducing the fundamental attitudinal changes typical of socio-economic modernization.

The development of a transportation system linking together a country's population, measured by the second variable, is an essential determinant of the spread of both the geographic and the psychic mobility characteristic of modern societies and is therefore also basic to the transformation of attitudes and ideas inherent in modernization.

The final variable, the size of the nonmonetized traditional agricultural sector, is negatively related to the degree of modernization of outlook. Its inclusion in the equation emphasizes the familiar fact that the commercialization of the agricultural sector is a key mechanism for inducing socio-psychological as well as economic modernization.

Viewed broadly, the equation for attitudinal modernization suggests that the underlying influences most conducive to transforming ideas and attitudes in low-income countries are the geographic linking together of the population through the creation of transportation networks and the economic integration of the country by means of the spread of the market throughout the nation.

### *Leadership Commitment to Economic Development*

It is often stressed that effective national leadership in the economic arena is a positive and frequently indispensable force in the process of economic development. This need for leadership is particularly great in contemporary low-income countries because of the inadequate capacity of their private sectors to initiate sustained economic growth and the marked deficiencies in their physical and social overhead capital.

The leadership commitment function in our model comprises three independent variables: the extent of political stability ( $X_{50}$ ), the degree of modernization of outlook ( $X_{31}$ ), and the political strength of the traditional elite ( $X_{46}$ ).

$$(4) \quad X_{49} = .57X_{50} + .33X_{31} - .16X_{46} \quad R^2 = .45$$

$$(7.13) \quad (3.58) \quad (-1.97)$$

The positive association of greater political stability, portrayed by the first variable, with more effective development efforts by national official and semiofficial agencies is logical since grave internal strife and dissension constitute important barriers to effective leadership action in economic matters. Thus, only when serious political instability is significantly reduced can the affected governments attend successfully to the business of economic growth.

The inclusion of the indicator of the degree of modernization of outlook, the third variable, in the leadership equation reflects the fact that general attitudinal changes favorable to socio-economic modernization can contribute significantly to the development of a national leadership dedicated to removing institutional blocks to economic growth.

Finally, the association of weaker traditional political elites, represented by negative changes in the third variable, with stronger leadership commitment expresses the necessity for breaking the control of tradition-oriented governments before the various agencies involved in central guidance of the economy can take effective action to support widespread economic growth.

Thus, the model suggests that, broadly speaking, the creation of a stable political environment, the transformation of attitudes in a direction favorable to modernization and a fundamental change in the power



elite are the forces which, in combination, are most likely to produce more effective national efforts to achieve economic progress.

### *Improvement in Agricultural Productivity*

Recent analyses of economic growth invariably emphasize that improved techniques in agriculture are essential if agricultural output is to meet the increased demand for food and raw materials that typically accompanies urbanization and industrialization. First of all, if agricultural supplies prove inadequate, the resultant shift in the internal terms of trade against industry can seriously impede the growth of industrial production. In addition, as industrialization proceeds, the increased food requirements of the growing population must generally be produced by a relatively smaller agricultural work force. As a result, countries with greater capacity for increasing agricultural productivity can be expected to have higher development potential than those with a lesser ability for technical improvement in agriculture.

The relevant function in our model relates improvements in agricultural productivity to the character of agricultural organization ( $X_{20}$ ) and the degree of improvement in financial institutions ( $X_{13}$ ).

$$(5) \quad X_7 = 18.9 + .35X_{20} + .48X_{13} \quad R^2 = .53$$

(4.61)    (3.74)    (5.25)

The dependence of capacity to raise agricultural output upon the institutional framework of agriculture, summarized by the first variable, is hardly surprising since responsiveness to market opportunities is less likely to occur where benefits of increased output do not accrue to the cultivator or where land holdings are subdivided into extremely small units.

The inclusion of a financial variable in the equation for agricultural improvements expresses the critical role of the increased availability of long-term credit in making possible the adoption of new techniques in agriculture.

In general, the model suggests that the rate at which agricultural productivity can advance is constrained primarily by forces operating on the supply side, in particular, the existence of institutional arrangements unfavorable to market responsiveness and the presence of inadequacies in the flow of long-term credit to the agricultural sector.

### *Agricultural Organization*

As has frequently been noted, the performance of the agricultural sector can be significantly improved by institutional arrangements favorable to the strengthening of incentives to increase output. Specif-

ically, changes in land tenure patterns linking output to effort, measures to reduce excessive fragmentation of land, and the spread of commercialization throughout the agricultural sector all constitute reforms in agricultural organization tending to increase responsiveness to market stimuli.

The explanatory variables in the equation for the character of agricultural organization in our model are the level of adequacy of physical overhead capital ( $X_8$ ), the size of the traditional agricultural sector ( $X_5$ ), and the extent of leadership commitment to economic development ( $X_{49}$ ).

$$(6) \quad X_{20} = .34X_8 + 42.3 - .44X_5 + .21X_{49} \quad R^2 = .71$$

(2.65) (4.25) (-3.45) (3.05)

The positive association between the adequacy of physical overhead capital, depicted by the first variable, and the character of agricultural organization reflects the crucial role of transportation networks in providing the physical means for the commercialization of the agricultural sector.

The inclusion in the equation for the character of agriculture of the size of the traditional agricultural sector with a negative sign expresses directly the fact that the monetization of the traditional subsistence sector represents an improvement in agrarian structure.

The final variable in the equation, the extent of leadership commitment to economic development, is probably included because concerted leadership efforts are required to initiate and carry out effective land reform.

To summarize, according to the model, the forces that are significant in explaining improvements in agrarian structure are the spread of transportation networks, the penetration of the market into the agricultural sector, and the extent of national policy measures that strengthen incentives for increasing agricultural output.

### *Agricultural Sector*

As noted above, a crucial aspect of the economic growth of low-income countries is the process of commercialization of the traditional subsistence agricultural sector. Its importance derives from the fact that the spread of the market into agriculture both provides the incentives for producing a surplus above consumption needs and simultaneously provides the agricultural population with cash incomes that increase domestic demand for industrial goods.

Our model relates the size of the nonmonetized traditional agricultural sector to the extent of dualism ( $X_{11}$ ), the level of adequacy of physical overhead capital ( $X_8$ ), and the extent of literacy ( $X_{21}$ ).

$$(7) \quad X_5 = -.28X_{21} - .35X_8 - .25X_{26} + 95.6 \quad R^2 = .81$$

$$(-3.51) \quad (-3.47) \quad (-3.18) \quad (3.40)$$

The negative relationship between the extent of dualism, the first variable, and the size of the subsistence agricultural sector expresses the close interaction between the rise of a modern sector and the subsequent spread of modern economic activity (positive changes in dualism) and the commercialization of the traditional agricultural economy.

The second variable in the equation, the adequacy of physical overhead capital, is inversely related to the size of the traditional agricultural sector because of the importance of transportation networks in expanding the marketing of agricultural produce and in facilitating the distribution of consumers goods to the agricultural population.

The association of greater literacy, summarized by the third variable, with reductions in the size of the subsistence sector expresses the fact that literacy is a key mechanism for transmitting attitudes favorable to economic modernization and participation in the spread of the market economy.

In general, therefore, the important influences tending to reduce the extent of subsistence agriculture are the generalization of economic growth stimulated by the rise of a modern sector, the physical linking of the modern sector with the hinterland and the increased psychic contact between agricultural and urban populations made possible by the growth of literacy.

### *Dualism*

A salient characteristic of many underdeveloped countries at very low levels of income is a marked socio-economic cleavage between an expanding market-oriented enclave and the traditional agricultural economy. As economic growth proceeds, positive changes in dualism involve reductions in the cleavage between modern and traditional sectors by means of the expansion of the market throughout the nation and increased intersectoral flows of factors of production. The extent to which this process of economic integration proceeds is often stressed to be a significant determinant of capacity for economic growth in the short run.

The variables associated with the extent of dualism in our model are the availability of physical overhead capital ( $X_8$ ), the importance of the indigenous middle class ( $X_{24}$ ), and the degree of modernization of outlook ( $X_{21}$ ).

$$(8) \quad X_{21} = .47X_8 + .36X_{24} + .21X_{31} \quad R^2 = .83$$

$$(5.16) \quad (5.92) \quad (2.51)$$

The buildup of a nation-wide transportation network, represented by the first variable, is a necessary condition for the generalization of economic growth which is inherent in positive changes in dualism.

The second variable in the equation reflects the importance of the rise of an indigenous middle class for the evolution of an integrated market sector. Specifically, in order for the growth process to become pervasive, it is essential that a class of indigenous traders, professionals, entrepreneurs, and public servants be created to act as agents for the spread of the market throughout the economy.

The degree of modernization of outlook, the third variable in the equation, depicts the close interaction between the general transformation of attitudes characteristic of modernization and the expansion of market-oriented activities.

In summary, the generalization of economic growth that is intrinsic in positive changes in the extent of dualism is significantly dependent, according to our model, upon the creation of a nation-wide transportation network, the growth of a class of indigenous entrepreneurs and traders, and a fundamental transformation of attitudes favorable to economic change.

### *Human Resources*

Contemporary studies of development frequently underline that the level of development of the educational system of a low-income country is a critical constraint on the supply of skills to its expanding industrial sector. In this connection, national capacity to provide secondary and specialized advanced training is particularly important as a determinant of the extent to which bottlenecks in the supply of professional technical, and managerial services can be eliminated.

According to the equation in our model, the important influences upon the rate of development of skilled human resources are the extent of dualism ( $X_{21}$ ), the extent of literacy ( $X_{26}$ ), and the change in the degree of industrialization ( $X_4$ ).

$$(9) \quad X_{33} = .33X_{21} + .40X_{26} + .25X_4 \quad R^2 = .77$$

(4.23)      (4.40)      (3.59)

The inclusion of both dualism and changes in industrialization as explanatory variables in the function for human resources reflects the impact of increases in the demand for educated manpower upon the speed of educational advances. With respect to the extent of dualism, the first variable, the penetration of economic growth throughout the economy generalizes demand for the more trained manpower typically required for market-oriented activities. As for changes in the degree of industrialization, the third variable in the equation, a rapidly growing

industrial sector increases greatly the demand for both skilled industrial labor and trained managerial talent.

The association of greater literacy, summarized by the second of the three variables, with a more successful higher educational system is evidence that the general level of primary education imposes a significant constraint upon the rate of increase in the supply of trained manpower. This relationship also suggests the presence of underlying economic and social limits to educational improvements common to both primary and higher education.

Thus, both demand and supply influences upon the rate of improvement in human resources through education are represented in our model. Demand effects are the result of changes in the structure of production and of the generalization of economic expansion, while supply effects depend upon the constraints on the capacity of the educational system.

### *Industrialization*

The close association between industrialization and per capita GNP is one of the most familiar characteristics of economic development. Among the important reasons often cited for this relationship are the changes in the composition of consumer demand in favor of nonfood products that take place as incomes rise, the shift in comparative advantage in favor of domestic production that occurs when domestic markets and levels of skill and technology increase, and the growth of intermediate demand for industrial products resulting from the expansion of consumer good industries.

The regression function for the change in the degree of industrialization relates changes in industrial structure to the extent of improvement in financial institutions ( $X_{13}$ ), the rate of improvement in human resources ( $X_{33}$ ), and the political strength of the military ( $X_{17}$ ).

$$(10) \quad X_4 = .45X_{13} + .36X_{33} + .13X_{17} \quad R^2 = .65$$

(5.24)      (4.55)      (2.02)

The positive role of the provision of credit in promoting industrialization, expressed by the first variable in the equation, arises because, as has been stressed by Schumpeter,<sup>8</sup> credit acts as a catalyst for the transfer of real resources among sectors and firms, and thus decreases the rigidity of the economy. This transfer stimulates changes in industrial technology and facilitates increases in the extent of industrialization.

Investment in man, represented by the second variable, removes critical constraints upon the rate at which industrialization can proceed since it helps supply the skilled, professional, technical, and clerical manpower that are required for the expansion of industry. As already

discussed, there is at the same time causation in the opposite direction as the increased demand for manpower caused by industrialization stimulates greater investment in education.

The final association in the function is between industrialization and the political strength of the military. This relationship reflects the fact that, historically, the military has frequently played a modernizing role in the development process and has shown a predilection for industrialization particularly through the expansion of heavy industry.

Thus, according to the model, the speed with which a country industrializes depends upon the rapidity with which finance and skilled human resources are provided and, to a lesser extent, upon the presence of a type of leadership typically favorable to industrialization.

### *Literacy*

It has often been stressed that economic growth and the development of human resources are intimately related. Above all, the successful establishment of an industrial base requires the creation of a literate trained labor force committed to urban industrial patterns of living.

The explanatory equation for the extent of literacy includes the indicators of the extent of mass communication ( $X_{27}$ ) and the rate of improvement in human resources ( $X_{28}$ ).

$$(11) \quad X_{28} = .46X_{27} + .42X_{28} \quad R^2 = .73$$

(4.93)      (4.36)

The positive association between mass communication, the first variable, and literacy derives from the positive impact of the spread of newspapers and radios (the two elements in the definition of the extent of mass communication) in increasing the demand for greater literacy among the populations of low-income countries.

The second variable in the equation, the rate of improvement in human resources, helps explain variations in the extent of literacy in part because the amount of investment in higher-level education (measured by the human resources variable) operates as a crucial restraint on the rate at which primary education and thus its key product, literacy, can be expanded. Another reason for this association is that, to a significant extent, the underlying social and economic limits to the expansion of a low-income country's educational system are common to both elementary and higher-level schooling.

In general, the literacy function in our model suggests that the rate of literacy depends concurrently upon the strength of incentives among the population for acquiring primary schooling and the capacity of the educational system of a nation to supply its population with a primary education.

*Middle Class*

Economic historians frequently emphasize that the historical growth of an indigenous middle class of manufacturers and traders in western European countries provided a source of entrepreneurial talent and "spirit" that contributed significantly to their successful economic development. Development specialists emphasize in a similar manner the positive role of indigenous traders and entrepreneurs in the generalization of economic growth throughout contemporary underdeveloped countries.

The equation for the indigenous middle class in our model includes the extent of social mobility ( $X_{25}$ ) and the degree of improvement in financial institutions ( $X_{13}$ ).

$$(12) \quad X_{24} = 21.68 + .75X_{25} + .22X_{13} \quad R^2 = .78$$

(8.24) (12.13) (3.64)

The close association of increased social mobility, described by the first variable, with a larger indigenous middle class undoubtedly reflects the effect of increased opportunities for economic and social advancement in stimulating the expansion of entrepreneurial and other middle-class activities. There is, of course, also causation in the opposite direction since the growth in the size of the middle class accompanying industrialization simultaneously enlarges opportunities for social advancement.

The inclusion of a financial indicator as the second variable in the equation for the indigenous middle class is clearly because successful improvements in financial institutions both foster the growth of private saving and provide credit for the widespread expansion of private business activity. Indeed, the creation of credit may be viewed as the key mechanism by which entrepreneurs obtain control over the means of production and thus as an essential condition for the growth of an indigenous entrepreneurial class.

In conclusion, our model suggests quite logically that the growth of a permanent and stable indigenous middle class depends upon access to the opportunities provided by industrialization and the provision of finance for the expansion of indigenous entrepreneurial activity.

*Political Stability*

The importance of a stable political environment to effective economic performance need hardly be emphasized, since resources cannot be committed to long-term investment without reasonable certainty regarding the stability of the prevailing political system.

In our model, the characteristics which are associated with the extent

of political stability are the degree of social tension ( $X_{29}$ ) with a negative sign, the degree of improvement in agricultural productivity ( $X_7$ ), and, also negatively, the political strength of the military ( $X_{47}$ ).

$$(13) \quad X_{50} = 8.6 - 0.56X_{29} + 0.23X_7 - 0.36X_{47} \quad R^2 = .63$$

$$(11.22) \quad (-7.11) \quad (2.97) \quad (-4.58)$$

The close inverse relationship between the degree of social tension, the first variable, and the extent of political stability reflects the characteristic impact upon the political environment of social tension and discontent. In underdeveloped countries in particular, the strains and dissension created by the socio-economic transformations characteristic of the early stages of economic growth tend to be productive of political disaffiliation and violence.

The second variable in the political stability function, the degree of improvement of agricultural productivity, expresses the positive effect of widespread economic improvements in reducing political discontent and stress among the population and thus in facilitating the creation of stable national political institutions.

The negative association between the political role of the military (described by the third variable in the equation) and the extent of political stability is not surprising since a high incidence of military interventionism is a primary political cause of instability in countries that have not yet developed integrated and responsive political structures.

In general, the equation explaining variations in the extent of political stability points to the conjunction of social, economic, and political causes of political instability. Specifically, it suggests that reductions in underlying social tensions, the spread of economic betterment in rural areas, and decreases in the political power of military groups all have a significant impact in increasing the stability of the national political systems of underdeveloped countries.

### *Social Mobility*

The importance in flexibility in social structure to the capacity of low-income countries to expand economically is frequently underlined by development specialists. This is because reductions in social barriers to personal advancement favor the growth of a broadly based class of entrepreneurs without which economic change is unlikely to become pervasive. In view of the multifaceted nature of social mobility, our indicator of this aspect of social structure is a broad composite that measures the degree of access to middle-class occupations, the extent of educational opportunity, and the strength of ethnic and cultural barriers to social advancement.



In our model, the extent of literacy ( $X_{25}$ ), the importance of the indigenous middle class ( $X_{24}$ ), and (with a negative relationship) the political strength of the traditional elite ( $X_{46}$ ) emerge as the important determinants of the extent of social mobility.

$$(14) \quad X_{25} = .53X_{25} + .37X_{24} - .20X_{46} \quad R^2 = .88$$

$$(9.08) \quad (8.52) \quad (-5.99)$$

The first variable in the equation depicts the critical influence of increases in literacy in expanding individual capacities for social mobility. The essential role of literacy derives from the fact that it is the most elementary human skill necessary for personal advancement in an industrial society.

The inclusion of the growth of the indigenous middle class, the second variable in the social mobility equation, reflects the impact of expanding opportunities for advancement into middle-class occupations in promoting greater flexibility of social structure.

The negative relationship between the third variable, the political strength of the traditional elite, and social mobility expresses the fact that, as tradition-oriented leadership groups become politically less powerful, the political route to social advancement becomes more open.

Since social mobility is a many-sided feature of industrial societies, it is not surprising that it is determined in our model by several diverse, although interrelated, forces: the spread of the capacity for social communication through the literacy skill, the enlargement of economic opportunities and the weakening of political barriers to social advancement.

### *Exogenous Variables*

It will be recalled that in the present model variables not appearing in the discriminant function for which no satisfactory relationship could be found "explaining" more than 50 per cent of their overall variance are defined as exogenous.<sup>10</sup> There are five of these: the extent of mass communication ( $X_{27}$ ), the degree of social tension ( $X_{29}$ ), the level of adequacy of physical overhead capital ( $X_8$ ), the political strength of the military ( $X_{49}$ ), and the political strength of the traditional elite ( $X_{46}$ ).

The extent of mass communication, measured in our model by a composite of newspaper circulation and radios in use, has a positive effect in increasing development potential because newspapers and radios are important vehicles for stimulating interest in the acquisition of literacy, a skill that is crucial to the development of a trained labor force.

Increases in the degree of social tension affect capacity for economic

<sup>10</sup> Note that, with this definition, exogenous variables are not synonymous with instrumental variables.

performance adversely because social strains and discontent tend to produce political instability which in turn can seriously hamper leadership efforts to raise economic growth rates.

The level of adequacy of physical overhead capital has obvious relevance for growth potential since the availability of transportation sets limits to the expansion of the market sector and constrains the provision of other basic facilities necessary for economic growth.

The political strength of the military can influence growth prospects both favorably and unfavorably. On the negative side, military revolutions and coups tend to cause serious political instability, while on the positive side, the military frequently acts as a modernizing and socializing agent in the development process.

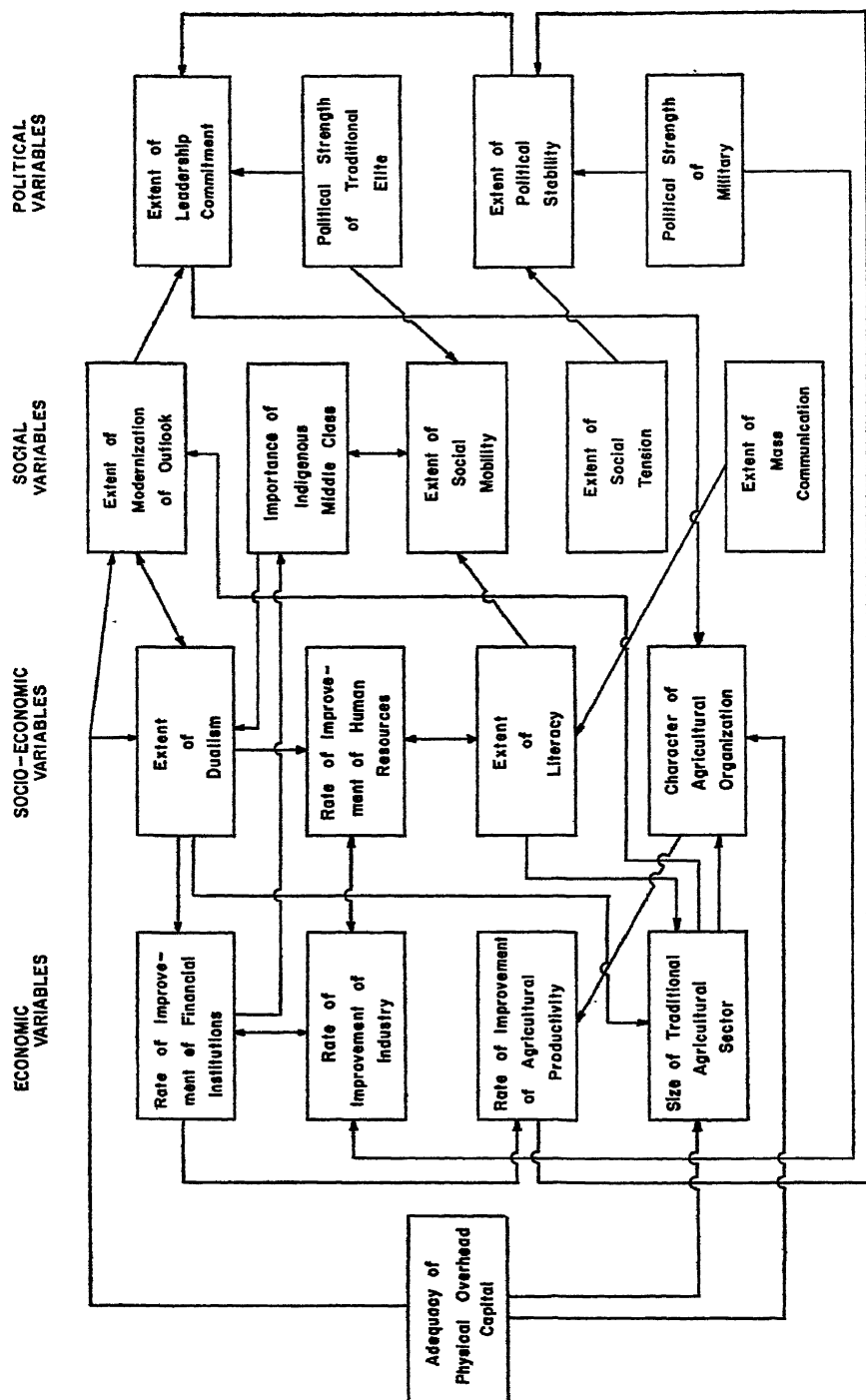
The political strength of the traditional elite, the last of the five exogenous variables, is important because, without leadership support of the processes of socio-economic modernization, underdeveloped countries typically cannot overcome the barriers to economic growth posed by the low level of development of their social and economic institutions.

### *Causal Structure of the Model*

Figure 1 can be helpful in investigating the causal structure of the model. The block of variables farthest to the left contains the five economic indicators; the next block includes four socio-economic variables; the third block consists of five social indicators; and the final right-hand block includes the four political variables. The heads of the arrows show the direction of causality with double arrowheads indicating mutually reinforcing feed-back relationships.

In all, there are 35 causal relationships in the model. The five economic variables account for approximately 34 per cent of the causal relationships; the four socio-economic variables account for another 28 per cent; and the five social variables account for 20 per cent. The political block is the most autonomous, contributing to only 17 per cent of the relationships.

Five of the 35 causal relationships are of the feed-back kind. First, the degree of improvement in financial institutions and the change in the degree of industrialization interact with each other; this is because more effective financial institutions make possible a faster rate of industrialization, while industrialization, by increasing the demand for finance, simultaneously stimulates financial improvements. More rapid industrialization and greater investment in human resources tend, each, to facilitate changes in the other in a similar manner. Next, the enlargement of the indigenous middle class favors increases in social mobility at the same time that reduced barriers to social advancement stimulate the expansion of the middle class. Another set of interactions is between



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positive changes in socio-economic dualism achieved through the generalization of economic growth and the spread of greater modernization of outlook. Finally, increases in the rate of improvement in human resources and in the extent of literacy each contribute to positive changes in the other in a mutually reinforcing manner.

It is of interest to examine in some detail the nature of the interrelationships involving, respectively, economic, socio-economic, social, and political variables. With regard to the indicators in the economic block, 33 per cent of the relationships expressed in the model are with other economic variables, 33 per cent with socio-economic variables, 25 per cent with social variables, and the rest with political variables. This pattern suggests strongly that recent attempts of development theorists to incorporate such partially noneconomic characteristics as changes in the extent of dualism and in the level of investment in human resources into the analysis of economic change are well advised. It is indeed a striking feature of the model that 66 per cent of the causal relationships of economic variables involve partially or totally noneconomic traits of society.

With respect to the socio-economic indicators in the model, 50 per cent of the causal relationships are with economic variables, 30 per cent with socio-economic variables, and 20 per cent with social variables. This picture tends, once again, to confirm the current tendency to incorporate the socio-economic characteristics of low-income countries into studies of economic development.

As for the social variables included in the model, 70 per cent of their causal relationships are with the social and socio-economic nexus, while 30 per cent are with the political variables.

The block with the smallest density of relationships with other sets of variables in the model is the political block. Political variables enter into only 17 per cent of the causal relationships of the model. Half of these relationships are with other political variables; of the remaining six, five are with social and only one with economic variables.

Thus Figure 1 illustrates graphically that social and socio-economic influences play a significant role in the process of economic development. In addition, it shows that political forces have considerably less weight than do social and economic factors in the systematic interactions determining patterns of economic growth.

#### IV. *The Multipliers*

A significant result obtainable from the present model of socio-economic and political change is a set of estimates of the relative impact of the various economic and noneconomic forces represented in the model upon the potential for economic development. These estimates are the

overall multipliers of the model and are obtained by simultaneous solution of its component equations.

Before discussing the multipliers, it should be recalled that they do not relate to economic growth narrowly defined but rather to the capacity of countries to develop economically as judged by recent performance with respect to a broad range of economic criteria. This focus derives from the fact that the model seeks to explain (1) the four critical characteristics, which in our original discriminant analysis provided an efficient composite index for classifying countries according to economic development potential and (2) the indirect influences that operate upon development potential through their effect upon the direct forces summarized by the discriminant function. The emphasis on capacity to develop should be borne in mind when interpreting the various multipliers.

Another comment concerning the multipliers may be in order. At first blush, one might be led to think that the variables characterized by one economic and socio-political scale are discrete, and that the concept of multipliers is therefore inappropriate to them. This argument would appear to be fallacious, however, since the phenomena represented by the variables included in the model are in fact all continuous. One can speak (as we do) of greater or lesser dualism, of more or less social mobility, etc. The only difference between our case and the more usual one is that deficiencies in information led us to scale our variables by means of a yardstick which has demarcations at coarse intervals only (e.g., feet or yards instead of inches).

The multipliers for the variables in the model are listed below in the order of their quantitative importance. Generally, multipliers are presented for exogenous variables only and are evaluated from reduced form equations. However, since in the present case, the classification of variables into endogenous and exogenous categories was made on statistical rather than on theoretical grounds, the multipliers are calculated for *all* the variables in the model. Thus, for purposes of evaluating the multipliers, each variable is regarded as exogenous in turn; for each variable, the multipliers may be presumed to characterize the effectiveness of small changes around its regression equation level.

In the calculation of each multiplier both the direct and indirect impact of changes in the relevant variable upon the discriminant function are taken into account. Specifically, for a given variable,  $x_i$ , the multiplier is given by the formula

$$\frac{dD}{dx_i} = \frac{\partial D}{\partial x_i} + \sum_{j \neq i} \frac{dD}{dx_j} \cdot \frac{\partial x_j}{\partial x_i} \quad \text{where } D \text{ is the discriminant index.}$$

A rough verbal translation of this equation would be that the overall

change in the index of development potential associated with a one-standard-deviation-change in a given variable ( $dD/dx_i$ ) consists of (1) any direct changes in development potential arising out of the interactions expressed in the discriminant function ( $\partial D/\partial x_i$ ) together with (2) the sum of all indirect effects by which the given variable influences development potential through its impact upon the other variables in the model which affect the four critical influences summarized in the discriminant function

$$\left( \sum_j \frac{dD}{dx_j} \cdot \frac{\delta x_j}{\delta x_i} \right).$$

Since the regression equations were presented in standardized form, these multipliers refer to the effects of roughly equi-probable changes in each of the variables of the model. Of course, small differences among multipliers should not be taken as indicative of "real" differences in effectiveness. We believe, however, that while a 20 per cent to 40 per cent difference in multiplier may not be indicative of a real difference, factors of two or more probably are.

The first three multipliers, in decreasing order of magnitude, are the degree of improvement in financial institutions (2.309), the degree of modernization of outlook (2.169), and the extent of dualism (2.133); all of these exceed 2, implying that a one-standard-deviation-change in each produces a two-standard-deviation-change in the value of the discriminant index. Next in importance are the level of adequacy of physical overhead capital (1.986) and the change in the degree of industrialization (1.624), whose multipliers are between 2.0 and 1.5. Then come the importance of the indigenous middle class (1.062), the rate of improvement of human resources (.955), and the extent of leadership commitment to economic development (.940), whose multipliers cluster around unity. The succeeding group, judged by the size of the multiplier, consists of the extent of literacy (.884), the degree of improvement in agricultural productivity (.823), and the extent of social mobility (.797); these indicators have multipliers between 1.0 and .75. Next come two variables whose multipliers lie around .5, the extent of political stability (.536), and the extent of mass communication (.407). The final group contains variables which in the model have a relatively small impact on development potential: the multipliers for the character of agricultural organization (.288) and the political strength of the military (.018) are between zero and .30; while the three variables in this group with negative multipliers all lie near  $-.30$ : the degree of social tension ( $-.300$ ), the political strength of the traditional elite ( $-.310$ ), and the size of the traditional agricultural sector ( $-.320$ ).

The model permits us to evaluate not only the magnitudes of the total

multipliers but also the relative contribution to each individual multiplier of each effect through which a particular variable operates. It is thus possible to trace through and compare the relative importance of the various mechanisms by which the influence of each variable is felt.<sup>11</sup>

We will now discuss each of the multipliers in turn, in the order of their magnitudes.

### *The Degree of Improvement in Financial Institutions (2.309)*

Since the variable representing financial improvements appears directly in the discriminant function for development potential, its overall multiplier consists of both direct and indirect effects. Specifically, 41 per cent of the total multiplier is due to the direct effect, while the remainder is accounted for by the impact of improvements in financial organization in promoting changes in the degree of industrialization (32 per cent), increases in agricultural productivity (17 per cent), and an expansion of the indigenous middle class (10 per cent). The first of these indirect effects expresses the role of increased credit in enabling the industrial sector to expand more rapidly. The second effect arises because financial improvements increase the supply of credit to agriculture and thereby permit the agricultural sector to improve production techniques in response to the expansion of the market. The final relationship contributing to the overall financial multiplier, that between improvements in financial organization and the strengthening of the indigenous middle class, reflects the positive impact of improved savings institutions and loan facilities in strengthening the financial base for indigenous entrepreneurial activities.

### *The Degree of Modernization of Outlook (2.169)*

The direct effect of this variable upon growth potential contributes approximately 64 per cent of its total effect. The indirect effects that account for the remainder, operate through the influence of increased modernization of outlook in inducing greater socio-economic integration (22 per cent) and in strengthening leadership commitment to economic development (14 per cent). With respect to the first of these, the spread of modern ideas and attitudes tends to facilitate the process of economic, technological, and socio-cultural integration summarized by increases in the dualism indicator. As for the second effect, underlying attitudinal changes favorable to wider participation in modern-type institutions can contribute significantly to the strengthening of leadership efforts to undertake an effective development program. Thus, while the most important consequence of increased modernization of attitudes in the model is its direct impact in raising potential for development, it also

<sup>11</sup> See Appendix B for a listing of the multiplier equations.

operates indirectly to increase both private and public initiative in expanding the area of economic activity.

*The Extent of Dualism (2.133)*

The role of dualism in explaining growth patterns is the cornerstone of several recent theories of economic development; appropriately, therefore, its multiplier is one of the highest of those emerging from our model. The rise of a modern sector and the subsequent generalization of economic growth throughout the country that are intrinsic in positive changes in dualism operate upon development potential in the model through both economic and social channels. Along economic lines, 36 per cent of the total multiplier is due to improvements in financial structure that are stimulated by the growth of modern industry and by the ensuing process of economic integration; second, the spread of economic growth inherent in changes in dualism brings about the commercialization of the traditional nonmonetized subsistence sector, an effect which accounts for 4 per cent of the total multiplier. A socio-economic channel by which the positive impact of dualism influences growth prospects is through its effect in expanding the demand for skilled labor; this sequence leads to increases in the rate of improvement in human resources which contribute 15 per cent to the total multiplier. The final mechanism by which dualism affects capacity for development according to the multiplier equation is purely social. The spread of growth-inducing interactions between the modern and traditional sectors entails changes in socio-cultural attitudes conducive to participation both in market-oriented activities and in other aspects of socio-economic and political modernization. The importance of this effect is evident in the fact that the degree of modernization of outlook contributes 45 per cent to the total multiplier for the extent of dualism.

*The Level of Adequacy of Physical Overhead Capital (1.986)*

The influence of physical overhead capital upon development potential operates in the model through its impact upon the degree of modernization of outlook, the extent of penetration of the market throughout the economy, and the character of agricultural organization. Improvements in transport networks contribute to the spread of modern ideas and attitudes by facilitating physical contact between urban and rural areas, an effect which accounts for 39 per cent of the total multiplier. The development of transportation also stimulates the commercialization of agriculture, a process represented in the multiplier equation by the impact of transport improvements in inducing both positive changes in dualism (51 per cent) and reductions in the importance of the subsistence agriculture (6 per cent). The final consequence for growth poten-



tial of the expansion of physical overhead capital is expressed in the model through its effect in providing incentives for changes in land tenure patterns favorable to increased agricultural output (5 per cent).

*The Change in the Degree of Industrialization (1.624)*

The promotion of industrialization forms one of the keystones of practical development planning. In our model, a more rapid rate of industrialization increases capacity for economic growth by promoting the development of both the financial organization and the human resource base of the economy. The most important of these mechanisms functions through the impact of industrialization in bringing about improvements in financial institutions. This effect contributes 85 per cent to the total multiplier for the change in the degree of industrialization. The remaining 15 per cent is accounted for by the role of rising industrial demand for skilled labor in stimulating measures to increase the capacity of the education system.

*The Importance of the Indigenous Middle Class (1.062)*

The primary paths by which the enlargement of the indigenous middle class increases capacity for development in our model are through its contributions to socio-economic integration (contributing 72 per cent of the total effect) and to increases in social mobility (accounting for the remainder). With respect to the first path, the middle class is a foremost source for the human agents for advancing the process of socio-economic integration. As for the second path, increases in the relative importance of middle-class occupations enhance economic opportunities for social advancement, thereby increasing overall social mobility.

*The Rate of Improvement in Human Resources (.955)*

The impact upon development potential of expanding secondary and higher-level education is summarized in the model by two sets of interactions. First, extensions to the educational system which contribute to an increased supply of skilled manpower make possible the more rapid growth of the industrial sector; this effect accounts for 61 per cent of the total multiplier. Second, increases in the pace at which higher-level personnel are trained remove an important constraint on the rate at which primary education, and thus literacy, can be expanded; this effect contributes 39 per cent to the multiplier for improvements in human resources.

*The Extent of Leadership Commitment to Economic Development (.940)*

The strengthening of national measures to promote economic development has a significant primary impact in our model in raising the capac-

ity of underdeveloped countries to grow economically, as is evident from its direct contribution of 94 per cent to the total multiplier for this variable. The remainder of the aggregate multiplier is accounted for by the influence of increased leadership commitment to development in promoting improvements in land tenure patterns. This latter effect is logical since a good test of the extent to which leaders support economic growth is their willingness to institute land reform.

### *The Extent of Literacy (.884)*

As might be expected, the spread of literacy is quite pervasive in its consequences in the model and operates primarily through socio-economic mechanisms rather than strictly economic ones. The most important channel whereby literacy increases growth potential is through its positive influence in expanding the capacity of individuals to move upward economically and socially; this effect contributes 48 per cent to the overall multiplier. The next most important way in which literacy affects growth is through the improvements in the supply of higher-level human resources that it stimulates, an effect accounting for 43 per cent of the total multiplier. The smallest indirect consequence of literacy expressed in the multiplier function is summarized by the inclusion (with a negative sign) of the size of the traditional agricultural sector (9 per cent). The reason for this effect is that literacy, by increasing psychic contact between rural areas and urban centers, spreads modern ideas and desires which contribute to the commercialization of the subsistence sector.

### *The Degree of Improvement in Agricultural Productivity (.823)*

The positive role of improvements in agricultural productivity in increasing the growth prospects of underdeveloped economies is reflected in our model primarily by the large direct impact of agricultural improvements expressed in the discriminant function. This relationship contributes 85 per cent to the multiplier for this variable. The residual 15 per cent is explained by the fact that improved techniques in agriculture permit increases in the standard of living of the rural population which tend to reduce political discontent and unrest, thus contributing to the overall stability of the political system.

### *The Extent of Social Mobility (.797)*

Increases in social mobility raise growth potential in the model uniquely because they tend to expand the size of the indigenous middle class. Specifically, the spread of education, the increase in economic mobility, and the reduction in socio-ethnic barriers to advancement, which are inherent in improvements in social mobility all favor the more

rapid movement of the indigenous population into entrepreneurial and other middle-class occupations.

*The Extent of Political Stability (.536)*

The sole effect of increases in political stability upon growth potential in the model is through their positive contribution to the effectiveness of leadership in the economic realm. This is because, as the political climate becomes more stable, leaders can devote more of their energies to long-run goals and less to the fight for short-run survival.

*The Extent of Mass Communication (.407)*

The influence of mass communication media operates upon development prospects in the model through a single mechanism, the extent of literacy. In particular, the spread of access to radios and newspapers, not only in the cities but also throughout the countryside, tends to increase significantly incentives to acquire the literacy tool, thus raising the national demand for primary education.

*The Character of Agricultural Organization (.288)*

Changes in the institutional structure of agriculture influence development capacity in the model economy uniquely through their effect upon agricultural productivity. The spread of freehold farming, the commercialization of the agricultural sector, and the enlargement of uneconomic farming units, all of which are positive changes with respect to agrarian structure, provide increased incentives to farmers to respond to market opportunities by the application of better techniques of production. The resultant increases in the productive capacity of the agricultural sector are of course important to the expansion of a country's potential for economic development.

*The Political Strength of the Military (.018)*

In the model, the net effect of increases in the political power of the military upon the capacity of an economy to grow is extremely small because of the action of two counteracting influences. On the positive side, the military frequently supports more rapid industrialization, an influence favorable to economic growth. On the negative side, the increases in political instability associated with military coups and revolutions tend to impair capacity to grow economically by diminishing leadership commitment to economic development. This negative effect of the military offsets almost completely its favorable influence in the model so that the net positive impact expressed by the multiplier is negligible.

*The Degree of Social Tension (-.300)*

This variable has an adverse effect upon the growth prospects of the model economy. The unfavorable impact of increases in social tension is the outcome of their contribution to greater political instability which in turn decreases the effectiveness of leadership in the economic realm.

*The Political Strength of the Traditional Elite (-.310)*

The beneficial influence upon development potential of reductions in the political strength of the traditional elite is expressed in the model by the negative value of its overall multiplier. Almost half (49 per cent) of the total effect is due to the fact that, since tradition-oriented governments do not usually act effectively to promote growth, a weakening in their power permits greater leadership commitment to economic development. The remainder of the effect of this variable (51 per cent) arises because the attenuation of the political power of tradition-oriented elites can contribute significantly to increased social mobility by reducing an important political barrier to social advancement.

*The Size of the Traditional Agricultural Sector (-.320)*

Reductions in the size of the nonmonetized subsistence agricultural sector have two consequences for growth potential in the model: they increase the degree of modernization of outlook (60 per cent) and induce changes in agricultural organization (40 per cent). As for the first effect, the commercialization of subsistence agriculture gives rise to modernizing attitudinal transformations favorable to economic change and development. The second element in the multiplier equation expresses the fact that the commercialization of agriculture constitutes in itself an important improvement in agrarian structure and in addition can stimulate reforms in land tenure systems.

*V. Summary and Conclusion*

In this paper, we have attempted to gain insight into the relevance for the process of economic development of social, political, and economic forces. For this purpose, a quantitative model has been formulated which focuses upon the determinants of potential for economic development. In addition, estimates have been made of the multipliers associated with each individual economic and noneconomic characteristic represented by the variables included in the model. The estimated multipliers yield indications of the prospective relative gains with respect to development potential from changes in various characteristics of the societies, economies, and polities of noncommunist under-developed nations.

Those aspects of national development that emerge in the model as important impediments to increasing capacity to develop are social and political as well as economic. The social bottlenecks, the elimination of which proves in the model to have particularly high payoff with respect to growth potential, are insufficient attitudinal modernization and a markedly dualistic structure of society. The absence of a sizable indigenous middle class, low levels of secondary education and literacy, and inadequate social mobility also constitute important obstacles to raising capacity for long-run growth. Economic improvements with a high impact in the model in increasing development capacity are improvements of financial institutions, increases in physical overhead capital, more rapid expansion of industry, and, to a lesser extent, technical modernization of agriculture. Finally, a single political characteristic, the extent of leadership commitment to economic development, has a significant effect in the model in raising capacity to perform economically.

In conclusion, it is to be hoped that the various noneconomic and economic features of low-income societies that appear in the present model to have particularly strong effects upon development potential may give some indication to social scientists of the most profitable directions for research into the determinants of inter-country variations in overall capacity to perform well economically in the long pull.

#### APPENDIX A: DEFINITION OF INDICATORS

As a mnemonic device, economic variables are given subscripts ranging from 1 to 19; social variables have indices ranging from 20 to 39, and political variables have subscripts of 40 or over. The variables which actually appear in the final form of the model are marked with an asterisk.

##### *Economic Indicators*

*Abundance of Natural Resources* ( $X_1$ ). The grouping of countries into categories by natural resource abundance was based upon information regarding the quantity and variety of fuel and non-fuel mineral resources together with data on the amount of agricultural land available per capita.

*Gross Investment Rate (1957-1962)* ( $X_2$ ). Countries were grouped according to the average ratio of gross investment to gross national product.

*Level of Modernization of Industry (1961)* ( $X_3$ ). This indicator combines three principal elements: the relative importance of *domestically* directed and financed modern power-driven industrial activities; the modernity of machinery and of organization patterns in the modern industrial sector; and the diversity and range of goods produced in the modern industrial sector.

*Change in Degree of Industrialization Since 1950\** ( $X_4$ ). This index is a composite of three statistical elements: the average rate of change (in constant prices) in industrial output; the increase in the proportion of GDP originating in industry; and the change in the proportion of industrial employment, all over the period 1950-1963.

*Size of the Traditional Agricultural Sector (1960)\* ( $X_5$ ).* This classification indicates the proportion of the population of less-developed countries engaged in traditional subsistence agriculture in which production was largely for self-contained indigenous communities and marketing of surpluses of incidental importance. Both modern commercial agriculture and indigenous cash-crop agriculture are excluded.

*Level of Modernization of Techniques in Agriculture (1961) ( $X_6$ ).* This indicator is a composite based upon the extent of use of mechanical power, fertilizer, and other modern techniques in agriculture, and the relative weight of traditional and of modern agriculture.

*Improvement in Agricultural Productivity Since 1950\* ( $X_7$ ).* This indicator distinguishes among countries by the extent to which they had experienced from 1950–1963 an increase in output greater than could be accounted for by additional inputs of the same quality as those prevailing in 1950. Indications concerning increases in the use of chemical fertilizer and mechanical power, the completion of modern irrigation systems, and extensions in the use of other modern agricultural techniques, provided the basis for this classification.

*Level of Adequacy of Physical Overhead Capital (1961)\* ( $X_8$ ).* Countries were grouped into four categories based upon the adequacy of internal transport systems (including roads, rail and waterways) and power networks in meeting current requirements for economic development.

*Improvement in Physical Overhead Capital Since 1950 ( $X_9$ ).* This is a composite indicator of improvements in transport systems. It did not prove desirable to broaden the indicator by including estimates of ratio of change of installed electrical capacity, primarily because, among the lower income countries in the sample, the construction of one or two small electric plants serving a small area often yielded disproportionately high percentage increases in total electric capacity.

*Level of Effectiveness of the Tax System (1961) ( $X_{10}$ ).* This indicator is a composite based upon: the proportion of total domestic government revenue to GDP; the ratio of direct tax revenues to total government revenues with, however, special treatment of countries in which a single foreign sector provided almost all direct tax revenues; the breadth of the tax base; and the efficiency of tax collections.

*Improvement in the Effectiveness of the Tax System Since 1950 ( $X_{11}$ ).* This index is a composite variable based upon the change between 1950 and 1963 in the ratio of domestic revenue to GNP, the average rate of increase in real domestic government revenues, and the change in the ratio of direct tax to total government revenues.

*Level of Effectiveness of Financial Institutions (1961) ( $X_{12}$ ).* This variable is a broad composite which combines both the success of financial institutions in attracting private savings and the extent to which they provided medium and long-run credit to the major sectors of the economy.

*Improvement in Financial Institutions Since 1950\* ( $X_{13}$ ).* Countries were classified on the basis of statistical measures of the extent of increase from 1950 to 1963 in both the volume of private savings flowing through

the banking system and the volume of medium- and long-term lending by the banking system to the private sector.

*Structure of Foreign Trade (1961) ( $X_{14}$ )*. This indicator is a statistical composite measure of the extent to which developing countries had shifted from the exporting of primary products and raw materials to the exporting of processed and manufactured commodities and the extent to which the exports had become diversified.

### *Social and Socio-Economic Variables*

*Character of Agricultural Organization (1960)\* ( $X_{20}$ )*. This index combines indices of land tenure patterns and size and orientation of farming units. Various types of agrarian structure are located along a scale, one end of which is represented by communally owned agricultural lands in which the marketing of crops is only of incidental importance, and the other end of which is depicted by commercial agriculture in which owner operated farms are sufficiently large to be economically viable. Intermediate on the scale are tenant-operated subsistence farms and large owner-absentee commercial farms or plantations.

*Extent of Dualism (1960)\* ( $X_{21}$ )*. This index stratifies countries by the presence and extent of socio-economic and technical dualism. At one pole are the largely agrarian societies having extremely small exchange sectors; at the other pole are countries with continuous interaction between modern and non-modern elements. Intermediate are societies in which a foreign-financed and directed modern sector is superimposed upon a predominantly agrarian society and countries in which the growth of an indigenous small-scale cash-crop sector using conventional techniques evolves at the expense of a traditional subsistence sector.

*Extent of Urbanization (1961) ( $X_{22}$ )*. The categories of this index are defined in terms of the proportion of the population living in urban areas containing over 20,000 people.

*Character of Basic Social Organization (1960) ( $X_{23}$ )*. This classification is based upon the predominant character of a less-developed country's basic social unit. Countries were grouped into three principal categories with countries in which the predominant form of social organization was the immediate family group at the top, and countries in which strong tribal allegiances were widespread at the bottom.

*Importance of the Indigenous Middle Class (1960)\* ( $X_{24}$ )*. This classification is based upon the relative size and political importance of indigenous people in middle class occupations in less-developed countries. Middle class occupations are interpreted to include entrepreneurs, and managerial, technical, administrative, commercial and banking employees.

*Extent of Social Mobility (1960)\* ( $X_{25}$ )*. This classification is based upon a composite measure of several aspects of social mobility, including the extent of racial or cultural barriers to mobility, the extent of educational opportunity, and access to membership in the middle class.

*Extent of Literacy (1958)\* ( $X_{26}$ )*. This classification groups countries by the percentage of population aged 15 and over which is literate.

*Extent of Mass Communication (1960)\** ( $X_{27}$ ). This classification is based upon a composite measure of newspaper circulation and of radios in use, in which the former is given the greater weight.

*Degree of Cultural and Ethnic Homogeneity* ( $X_{28}$ ). In defining this indicator three country characteristics were combined into a single index: the extent of linguistic, religious, and racial homogeneity. The element receiving the greatest weight was the proportion of the population speaking the dominant language.

*Degree of Social Tension (1957-1962)\** ( $X_{29}$ ). This classification is a qualitative one based on the extent of evidence of overt social tension in the form of considerable and social instability arising from racial, tribal, religious, or cultural tensions.

*Crude Fertility Rate (1955-1959)* ( $X_{30}$ ). This index is based upon estimates of crude fertility rates.

*Degree of Modernization of Outlook (1960)\** ( $X_{31}$ ). This classification is a composite measure of the degree of modernization of outlook of educated urban groups and of the extent to which programs of political and economic modernization had gained the support of both rural and urban population.

*Degree of National Integration and Sense of National Unity (1957-1962)* ( $X_{32}$ ). This classification groups countries according to both cultural and political aspects of national integration. Statistical information concerning the proportion of population speaking a common language was combined with two qualitative aspects of integration: the degree of integration of local political structures with national political institutions and the prevalence among the population of a sense of national identity.

*Rate of Improvement in Human Resources (1961)* ( $X_{33}$ ). This indicator is based upon the Harbison-Myers composite index of level of human resource development and is a weighted average of secondary and higher level school enrollment ratios as a percentage of the relevant age group.

### *Political Variables*

*Extent of Centralization of Political Power (1957-1962)* ( $X_{40}$ ). This indicator defines four categories, the lowest of which is characterized by marked discontinuity between local traditional authorities and the central government, and the highest of which is characterized by a highly centralized, authoritarian central governmental structure. Intermediate between these are centralized nonauthoritarian governments and moderately centralized governments tending towards democratic decentralization.

*Strength of Democratic Institutions (1957-1962)* ( $X_{41}$ ). This index combines several elements: the presence of at least two reasonably effective competitive political parties; the freedom of political parties and other voluntary groups to oppose the government; the stability of political party systems; and the extent of experience with democratic forms.

*Degree of Freedom of Political Opposition and Press (1957-1962)* ( $X_{42}$ ). This index combines the degree of freedom of political opposition as indicated by freedom of groups to organize, operate and oppose the government, with the extent of freedom of the press. The former was weighted more heavily



in the final classification since it was felt to be a better indicator of the extent of genuine institutional freedom.

*Degree of Competitiveness of Political Parties (1957-1962) ( $X_{43}$ )*. This classification groups countries with respect to the number of political parties rotating control of the political system.

*Predominant Basis of the Political Party System (1957-1962) ( $X_{44}$ )*. This indicator is defined in terms of a scale, the lower end of which is marked by the absence of parties or by the dominance of a single party with nationalistic appeal and the upper end of which is characterized by articulate aggregative parties having a class or ideological orientation. Intermediate along the scale are countries in which political parties are generally personalistic rather than doctrinal or nationalistic, or countries in which the predominant basis of political parties was the regional ethnic-cultural or religious groupings of the population.

*Strength of the Labor Movement (1957-1962) ( $X_{45}$ )*. This indicator is a composite of several aspects of labor union strength: the extent of their political power, their freedom from political restrictions, their independence of government influence, and the extent of their popular support. Within each category a lower score was given to countries having a very small industrial labor force from which unions could potentially draw their membership.

*Political Strength of the Traditional Elite (1957-1962)\* ( $X_{46}$ )*. This indicator groups countries into three categories according to the political strength of the tradition-oriented elites during the period 1957-62. Traditional elites were interpreted to include both traditional land-holding elites and bureaucratic, religious, or military elites who favored the preservation of traditional, political, social and economic organizations, institutions, and values.

*Political Strength of the Military (1957-1962)\* ( $X_{47}$ )*. In defining this indicator countries were grouped into three broad categories determined respectively by a marked, moderate, or negligible extent of military interference in the political arena.

*Degree of Administrative Efficiency (1957-1962) ( $X_{48}$ )*. This classification is based upon several aspects of efficiency of administration in less-developed countries: the degree of permanence and training of administrators, the extent to which bureaucratic inefficiency and incompetence hamper government functioning, and the extent to which instability of policy at higher levels of administration promotes inefficiency.

*Extent of Leadership Commitment to Economic Development (1957-1962)\* ( $X_{49}$ )*. Three broad categories of leadership commitment were distinguished on the basis of the following judgments: (1) whether the heads of agencies involved in direct or indirect central guidance of the economy typically made concerted efforts to promote the country's economic growth; (2) whether or not this planning effort included serious attempts to alter the institutional arrangements which clearly block the achievement of planning goals; and (3) whether or not there was a national plan and a planning group

functioning within the government which was charged full-time with executing the plan.

*Extent of Political Stability (1950-1963)\** ( $X_{60}$ ). This classification groups countries according to the stability of their political systems over the period 1957-63. The degree of stability was judged by the frequency of changes in form of government, the frequency and violence of coups, the extent of political subversion and domestic violence, and the effectiveness of internal security.

#### APPENDIX B: MULTIPLIER EQUATIONS

$$\frac{dD}{dX_{13}} = .48 \frac{dD}{dX_7} + .45 \frac{dD}{dX_4} + .22 \frac{dD}{dX_{24}} + .95 = 2.309$$

$$\frac{dD}{dX_{31}} = .33 \frac{dD}{dX_{49}} + .21 \frac{dD}{dX_2} + 1.39 = 2.169$$

$$\frac{dD}{dX_{21}} = .33 \frac{dD}{dX_{13}} + .45 \frac{dD}{dX_{31}} + .33 \frac{dD}{dX_{33}} - .28 \frac{dD}{dX_5} = 2.13$$

$$\frac{dD}{dX_8} = .36 \frac{dD}{dX_{31}} + .47 \frac{dD}{dX_{21}} + .34 \frac{dD}{dX_{20}} - .35 \frac{dD}{dX_5} = 1.98$$

$$\frac{dD}{dX_4} = .60 \frac{dD}{dX_{13}} + .25 \frac{dD}{dX_8} = 1.624$$

$$\frac{dD}{dX_{24}} = .36 \frac{dD}{dX_{21}} + .37 \frac{dD}{dX_{25}} = 1.062$$

$$\frac{dD}{dX_{33}} = .36 \frac{dD}{dX_4} + .42 \frac{dD}{dX_{26}} = .955$$

$$\frac{dD}{dX_{49}} = .21 \frac{dD}{dX_2} + .88 = .940$$

$$\frac{dD}{dX_{26}} = .40 \frac{dD}{dX_{33}} + .53 \frac{dD}{dX_{25}} - .25 \frac{dD}{dX_5} = .884$$

$$\frac{dD}{dX_7} = .23 \frac{dD}{dX_{60}} + .70 = .823$$

$$\frac{dD}{dX_{25}} = .75 \frac{dD}{dX_{24}} = .797$$

$$\frac{dD}{dX_{60}} = .57 \frac{dD}{dX_{49}} = .536$$

$$\frac{dD}{dX_{27}} = .46 \frac{dD}{dX_{26}} = .407$$

$$\frac{dD}{dX_{20}} = .35 \frac{dD}{dX_7} = .288$$

$$\frac{dD}{dX_{47}} = .13 \frac{dD}{dX_4} - .36 \frac{dD}{dX_{50}} = .018$$

$$\frac{dD}{dX_{29}} = -.56 \frac{dD}{dX_{50}} = -.300$$

$$\frac{dD}{dX_{46}} = -.16 \frac{dD}{dX_{49}} - .20 \frac{dD}{dX_{25}} = -.310$$

$$\frac{dD}{dX_5} = -.09 \frac{dD}{dX_{31}} - .44 \frac{dD}{dX_{20}} = -.320$$

# A "DIFFUSION" MODEL OF INTERNATIONAL PRODUCTIVITY DIFFERENCES IN MANUFACTURING INDUSTRY

By RICHARD R. NELSON\*

Part I of this study examines certain important difficulties with existing formal theory purporting to explain international differences in output per worker in manufacturing, particularly differences between developed and underdeveloped countries. Part II presents a theoretical case for abandoning two central assumptions of that theory—that all firms can be considered as on the same neoclassical production function, and that factor markets are perfect and competitive. Basically the argument will be that manufacturing development should be modeled as an inter- and intranational diffusion process. Part III presents an empirical analysis of Colombian-United States productivity differences which supports the argument of Part II.

## I. *Problems with Existing Theory*

Over the past decade a considerable literature has developed attempting to explain cross-country differences in output per worker in manufacturing industry. The differences to be explained are substantial. If one believes the published figures, value added per worker in manufacturing in India is only about one-tenth that in the United States; in countries like Colombia, Japan, and Mexico, about one-quarter; in Western Europe roughly sixty per cent. These kinds of differences exist industry-by-industry, as well as for manufacturing as a whole.<sup>1</sup>

The descriptive and qualitative literature has contained a wide variety of variables which may explain the differences, and has employed (implicitly) a wide variety of models. However, in the more quantitative literature employing a formal model, the theoretical analysis almost invariably starts from two assumptions. The first is that within an industry, all firms, both within a country and in different countries are, in some basic sense, employing the same neoclassical production function. Differences in output per worker therefore ought to be explainable by

\* The author is professor of economics at Yale University, formerly at RAND. Any views expressed in this paper are those of the author. They should not be interpreted as reflecting the views of The RAND Corporation or the official opinion or policy of any of its governmental or private research sponsors. Several of the ideas presented in this paper are the result of, or have been significantly sharpened by, discussions with Donald Keasing, Edward Mitchell, and Sidney Winter. The data on Colombia, used in the final section, were obtained in the course of a study under contract to AID and reported in [13].

<sup>1</sup> The principal source of data for international manufacturing comparisons is the United Nations [20].

differences in the supply of complementary factors per worker. The second assumption is that factors are homogeneous and perfectly mobile within an industry in a country, and factor prices are determined on competitive markets. Prices or returns of different factors are the same for all firms in the country and can be used to estimate marginal productivity. Together these two assumptions imply that in each country the industry is the representative firm writ large. Intercountry productivity differences reflect differences in factor proportions employed by the representative firms.<sup>2</sup>

The point of view presented later in this paper breaks significantly from these assumptions. I have been led to adopt a quite different point of view in large part because of growing awareness that the early attempts to employ the model empirically suggested some basic problems with the neoclassical framework. It is useful therefore to set the stage by describing these problems.

The most useful point of departure is the study of Arrow, Chenery, Minhas, and Solow, which, within the above framework, attempted to relate cross-country differences in value added per worker to differences in the capital-labor ratio.<sup>3</sup> Capital and labor were defined so that their returns added up to value added; thus other factors implicitly were assumed to influence average quality or effectiveness of one or both of these two basic inputs.

For our purposes the pertinent questions to which their research pertains can be posed as follows: Given the observed level of value added per worker and of capital per worker in an industry in a less developed country, and assuming they stay on the same (common to all countries) production function, what would their value added per worker be if they had a capital-labor ratio equal to that in a developed country? How much of the observed difference in value added per worker can be explained, in the sense above, by the difference in the capital-labor ratio?

The answers, of course, depend on the "shape" of the production function. The basic assumptions constrain the shape. Output per worker,  $Q/L$ , must be an increasing and concave function of the capital-labor ratio,  $K/L$ , given other factors that will be denoted by  $Y$ . Thus:

$$(1) \quad \frac{Q}{L} = F \left\{ \frac{K}{L}, Y \right\} \quad F_1 > 0, \quad F_{11} < 0$$

Or, for a constant  $Y$ :

<sup>2</sup> In a way this is too strict. Several of the papers admit the possibility of total factor productivity differences across nations. But this is brought in as an empirical fact of life, not as something intrinsic to the basic model. For a survey of much of the relevant literature see Nerlove [14].

<sup>3</sup> See Arrow, *et al.* [1].

$$(1a) \quad \frac{Q}{L} = f \left\{ \frac{K}{L} \right\} f' > 0, \quad f'' < 0.$$

Notice that  $f(\cdot)$  may differ across countries if  $Y$  differs.

Observation of output and capital per worker, and of either the rate of return on capital or capital's share, permits quantitative specification of a point on the function, and the slope or elasticity of the function at that point (since the model implies that the rate of return on capital equals capital's marginal productivity):

$$(2) \quad \left\{ \frac{Q}{L} \right\}_0 = f \left[ \left\{ \frac{K}{L} \right\}_0 \right]$$

$$r_0 = f' \left[ \left\{ \frac{K}{L} \right\}_0 \right] \quad \text{or} \quad S_K^0 = - \frac{f' \left[ \left\{ \frac{K}{L} \right\}_0 \right] \left\{ \frac{K}{L} \right\}_0}{f \left[ \left\{ \frac{K}{L} \right\}_0 \right]}$$

where  $r$  and  $S_K$  are capital's marginal product and share, respectively, and the "0" refers to the existing situation.

This information suffices for estimation of the effect on output per worker of small changes in the capital-labor ratio. For large changes something must be known about the degree of concavity of the function—the rate of diminishing returns. This can be measured by the elasticity of substitution ( $E$ ) between capital and labor which determines how the elasticity of the function changes as the capital-labor ratio changes.<sup>4</sup>

$$(3) \quad \frac{d \log S_K}{d \log \left( \frac{K}{L} \right)} = (1 - S_K) \left( \frac{E - 1}{E} \right)$$

In general  $E$  will not be a constant, but will itself change with  $K/L$ . However, in the Arrow, *et al.*, specification, the production function is assumed to have a constant elasticity of substitution. Thus, if one knows a point on the curve, its elasticity or slope there, and the elasticity of substitution, one can specify the entire (partial) production function. One then can answer directly the two questions posed above.

As an example let us ask: how much larger would value added per worker be in Colombian manufacturing industry if Colombia had a capital stock per worker roughly comparable to that in the United States (but no other changes affecting productivity were made)? As of 1964 value added per worker in Colombia was about \$3,000 (compared with \$12,000 in the United States) and the capital-labor ratio was about

<sup>4</sup> For a proof see Nelson [11].

\$6,000 (compared with \$24,000 in the United States).<sup>5</sup> This is a point on the production function. The elasticity of the function at that point can be estimated by capital share—about .7. Let us take an estimate of the elasticity of substitution from Arrow, *et al.*, at about .6. (Later I shall discuss how they arrived at that figure.) Assuming a constant elasticity of substitution between capital and labor, equation (1a) can be written:<sup>6</sup>

$$(4) \quad \frac{\frac{Q}{L}}{\left(\frac{Q}{L}\right)_0} = \left[ S_K^0 \left[ \frac{\left\{ \frac{K}{L} \right\}}{\left\{ \frac{K}{L} \right\}_0} \right]^{\frac{E-1}{E}} + S_L^0 \right]^{E-1}$$

Calculations show that, if this function holds, output per worker would be slightly more than twice as great—approximately \$6,900—if the capital-labor ratio were the same as that in the United States, but

<sup>5</sup> Output per worker can be written

$$(1) \quad \frac{Q}{L} = A \left[ \delta \left\{ \frac{K}{L} \right\}^{(E-1)/E} + 1 - \delta \right]^{E/(E-1)}$$

The ratios of the factor shares can be shown to be

$$(2) \quad \frac{S_K}{S_L} = \frac{\delta}{1 - \delta} \left[ \frac{K}{L} \right]^{(E-1)/E}$$

Rewriting equation (1)

$$(3) \quad \frac{Q}{L} = A \left[ \delta \left\{ \frac{K}{L} \right\}_0^{(E-1)/E} \left[ \frac{\left\{ \frac{K}{L} \right\}}{\left\{ \frac{K}{L} \right\}_0} \right]^{(E-1)/E} + 1 - \delta \right]^{E-1}$$

Substituting from equation (2) and rearranging

$$(4) \quad \frac{Q}{L} = \frac{A \{1 - \delta\}}{S_L^0} \left[ S_K^0 \left[ \frac{\left\{ \frac{K}{L} \right\}}{\left\{ \frac{K}{L} \right\}_0} \right]^{(E-1)/E} + S_L^0 \right]^{E-1}$$

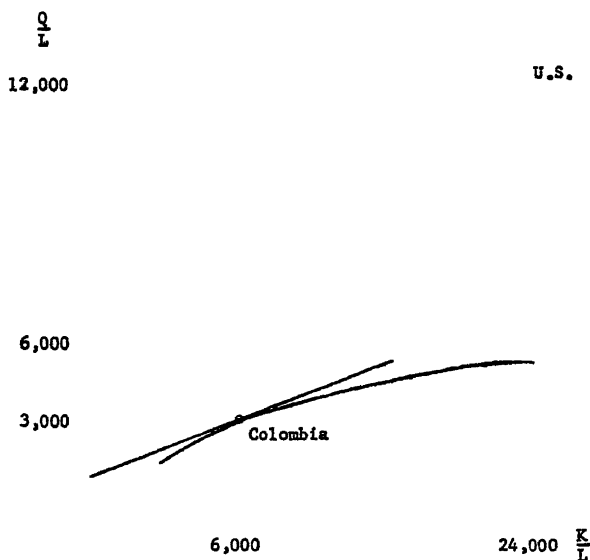
Recognizing that

$$\left\{ \frac{Q}{L} \right\}_0$$

must equal

$$(5) \quad \frac{Q}{L} = \left\{ \frac{Q}{L} \right\}_0 \left[ \frac{\left\{ \frac{K}{L} \right\}}{\left\{ \frac{K}{L} \right\}_0} \right]^{(E-1)/E} + S_L^0 \quad E-1$$

<sup>6</sup> This can be derived by manipulation of the CES equation.



Calculations assume that the elasticity of the function at  $\frac{K}{L} = 6,000$  is .7, and the Elasticity of Substitution is .6.

FIGURE 1. CES CALCULATIONS FOR A COLOMBIA-U.S. COMPARISON

other variables that influence relative productivities were not changed from existing levels in Colombia. Or, differences in the capital-labor ratio alone explain only about one-third of the observed productivity difference. It also should be noted, for future reference, that the rate of return on capital, which at Colombia's existing capital-labor ratio is somewhat greater than in the United States, would be significantly lower at a higher capital-labor ratio, if nothing else changed. All this is depicted in Figure 1.

What was just done is *not* exactly what Arrow, *et al.*, did. It is illuminating to examine the differences, which show why the result that there are significant unexplained productivity differences between countries has been largely unnoticed, and at the same time see how they obtained an estimate of the elasticity of substitution.

Arrow, *et al.*, were interested in explaining productivity differences among a number of countries, and for many of these reliable capital stock data did not exist. However, if one assumes, for the moment, that capital-labor ratio differences are the only distinguishing differences between rich and poor countries, from the general neoclassical production function and the assumption that labor is paid its marginal product, one



can obtain a monotonic increasing relationship between the wage rate and the capital-labor ratio:

$$(5) \quad w = g \left\{ \frac{K}{L} \right\}$$

This relationship provides an indirect measure of the capital-labor ratio, and permits (1a) to be written as follows:

$$(6) \quad \frac{Q}{L} = f[g^{-1}(w)] = h(w)$$

If one knows  $f(\cdot)$  one can specify both  $g(\cdot)$  and  $h(\cdot)$ . The reverse is in general not true. However the form of  $f(\cdot)$  implies a form for  $h(\cdot)$  and from estimates of some of the parameters of  $h(\cdot)$  one can infer some (but not all) of the parameters of  $f(\cdot)$ . In particular one can infer the elasticity of substitution. This is how Arrow, *et al.*, obtained their estimate of the elasticity of substitution.

Notice that in reality what is happening is that the elasticity of substitution is being estimated so as to fit the observed differences in labor share (or capital share) between high- and low-wage countries. Dividing both sides of (6) by  $w$  and inverting yields

$$(7) \quad \begin{array}{cc} Lw & w \\ Q & h(w) \end{array}$$

or

$$S_L = j(w)$$

It is an empirical fact that the share of labor is higher in high-wage countries than low-wage areas, and this will show up in the estimated parameters of (6). Since  $w$  is assumed to be related only to  $K/L$ , this means that, by (5) and (6), the equation will imply that wage share increases as the capital-labor ratio increases. This means that, as the model is specified, the statistical results will be interpreted as implying an elasticity of substitution between capital and labor of less than unity. (Note equation (3).)

But there clearly is something misspecified about the model. For where capital data are available it is possible to go back and estimate what output per worker would be at a different capital-labor ratio. The result should be that lifting the capital-labor ratios in poor countries to a level comparable to that in the United States should yield an output per worker estimate equal to that in the United States, plus a random error. As we have seen, it does not. Arrow, *et al.*, did not show this negative result the same way I did. Instead they used a factor price frontier argument that will be discussed, and employed, later. But first let us try to see what is misspecified about the model.

Let us maintain the key assumptions of the model—the common linear homogeneous production function and competitive factor pricing—but drop the special assumption used in equation (1a) that differences in capital labor ratios are the only differences between countries. Instead, let us admit, as before, that there may be other factors,  $Y$ , as well as  $K/L$ , that vary across countries and which affect both  $Q/L$  and the marginal productivity of labor (assumed to equal the wage rate):

$$(1) \quad \frac{Q}{L} = F\left(\frac{K}{L}, Y\right)$$

$$(8) \quad w = G\left(\frac{K}{L}, Y\right)$$

If, speaking intuitively,  $F(\cdot)$  and  $G(\cdot)$  have the same “isoquants” we can write

$$(9) \quad \frac{Q}{L} = H(w)$$

exactly as before.<sup>7</sup> If  $w$  and  $Q/L$  don't have exactly the same isoquants but are both positively related to both  $K/L$  and  $Y$ , one still would find a strong relationship between  $Q/L$  and  $w$ .

If this is what is going on, it explains why Arrow, *et al.*, can get such a good fit for their equation, while at the same time differences in capital-labor ratios alone explain only a small portion of intercountry productivity differences. For equations (9) and (6) are indistinguishable. The equation they actually fitted is consistent with a wide variety of factors, not just higher capital-labor ratios, that distinguish rich countries from poor. While something that might be called an elasticity of substitution can be derived, there is no reason why the number so estimated need have anything at all to do with an elasticity of substitution (holding other factors constant) between  $K$  and  $L$ .<sup>8</sup>

One implication of the above is that there is no reason why the Arrow, *et al.*, estimate of the “elasticity of substitution” should be employed in equation (4). However, if the “share equals elasticity” assumption is maintained, there is little explanatory leverage in the elasticity of substitution. If the elasticity of substitution is higher than .6 then diminish-

<sup>7</sup> More precisely, the set of inverse sets for  $G(\cdot)$  is identical to that for  $F(\cdot)$ .

<sup>8</sup> For example, consider two countries with exactly the same capital labor ratio, but one with a higher output per worker because of, say, higher educational attainments. Assume that the rate of return on capital is the same in both countries with the wage rate and, hence, wage share higher in the high income country. From the CES calculations described above the statistician would obtain an estimate of the elasticity of substitution between capital and labor (less than one), despite the fact that there is no difference in the capital-labor ratios in the two cases.

TABLE 1

$\frac{\left\{ \frac{Q}{L} \right\}}{\left\{ \frac{Q}{L} \right\}_0}$ as a function of $E$ , and $\frac{\left\{ \frac{K}{L} \right\}}{\left\{ \frac{K}{L} \right\}_0}$						
$\frac{\left\{ \frac{K}{L} \right\}}{\left\{ \frac{K}{L} \right\}_0}$						
		.4	.6	.8	1.0	1.5
	2	1.49	1.57	1.60	1.63	1.65
	4	1.88	2.28	2.50	2.64	2.81
	6	2.02	2.73	3.21	3.51	3.88

Calculations made using equation (4) in the text, assuming  $S_K^0 = .7$

ing returns will set in less rapidly and a higher capital-labor ratio will contribute more to higher output. But, as shown in Table 1, even with a very high elasticity of substitution, it still is not possible to explain more than half of the observed differences in value added per worker in this way. If a linear homogeneous production function, that is common to all countries, is assumed, and competitive factor pricing as well, then differences between rich and poor countries must transcend differences in the capital-labor ratio.

Let us return to how Arrow, *et al.*, deduced that differences in the capital-labor ratio could not be the whole story. A neoclassical production function with two factors of production, say capital and labor, implies a factor price frontier, if we assume competitive factor pricing. Thus, the general model:

$$\frac{Q}{L} = f \left\{ \frac{K}{L} \right\} ; \quad f' > 0 \quad f'' < 0$$

$$w = \frac{\partial Q}{\partial L}, \quad r = \frac{\partial Q}{\partial K}$$

implies a factor price frontier which can be characterized as follows:

$$(10) \quad 1(w, r) = 0, \quad \frac{\partial w}{\partial r} < 0$$

Both factor prices are uniquely related to  $K/L$ , one positively and one negatively. If the wage rate is higher in one country than another (because of more capital per worker), the rate of return on capital must be lower. Recall that the slope of  $f(K/L)$  declined with  $K/L$  in Figure 1.

However, several studies have shown little difference across countries in the rate of return on capital in a given industry, despite the very great differences in real wage rates.<sup>9</sup> In particular, it is clear that the rate of return on capital in high-wage countries is nowhere near as low, in comparison with the rate of return on capital in low-wage countries, as is implied by the factor price frontier, given the specification of the production function. It is this fact that led Arrow, *et al.*, to recognize that something else, as well as differences in capital-labor ratios, must distinguish high- from low-wage countries.

One might have expected this result. After all, there are international capital markets. The question then becomes, why does the rate of return on capital in less developed countries fall to roughly world levels at such a low capital-labor ratio? What are the key differences between less and more developed countries that repress both output per worker and the return to capital in the former?

E. Mitchell's study is the obvious next step: an attempt to put into the model some other factor that seems positively related to value added per worker.<sup>10</sup> His candidate is a measure of skill or educated endowments. His particular formulation is in terms of an index of skill mix of the labor force—which he designates by the ratio of skilled labor,  $L_1$ , to total labor,  $L$ .

$$(11) \quad \frac{Q}{L} = F\left(\frac{K}{L}, \frac{L_1}{L}, Y^*\right)$$

His model has considerably more explanatory power than the simpler one of Arrow, *et al.*, and further, it is able to deal with certain phenomena, that the simpler model cannot, such as systematic differences across countries in the capital-labor ratio associated with a given rate of return on capital (referred to above) and systematic differences across industries in the average wage rate.

It is unclear how much of the differences across countries in value added per worker the augmented model can explain. Some clues can be provided, as with the simpler model, by considering the factor price frontier. The Mitchell model implies a factor price frontier as follows:

<sup>9</sup> See Mitchell [10].

<sup>10</sup> For a summary, see Mitchell [10].

$$(12) \quad 1\{w_1, w_2, r\} = 0 \quad \frac{\partial w_i}{\partial r} \frac{1}{w_j} < 0 \quad \frac{\partial w_i}{\partial w_j} < 0$$

where  $w_1$  and  $w_2$  are the wages of skilled and unskilled labor. If one assumes  $r = \bar{r}$  (rates of return on capital do not differ much across countries), then if unskilled workers are paid more in high-income countries, skilled workers must be paid less, not just relatively but absolutely. For the result on the factor price frontier for a two factor model is easily generalized to a 3 or indeed an  $n$  factor model. If one factor is paid less in one situation (country) than in another, there must be at least one other factor that is paid more.<sup>11</sup> What limited data I have seen suggest that, if we exclude managerial personnel (which will be discussed later), this is not the case. Engineers, scientists, doctors, lawyers, skilled mechanics, all tend to be paid less, not more, in less developed countries than in more developed ones. In part there may be quality differences. But the so-called brain drain shows that many of these people can go from a country where they are "scarce" to one in which they are "plentiful" and earn more money.

If one drops the assumption of constancy across countries in rates of return on capital, and admits higher rates of return in low-wage countries, the conclusion is less clear. However, I suspect that there certainly are differences that transcend capital and skill endowments per worker.<sup>12</sup> As other factors are progressively brought into the analysis the unexplained residual will be further reduced. And clearly there are some im-

<sup>11</sup> Assume a linear homogeneous production function  $Q = f\{X_1 \cdots X_n\}$ . Assume price equals marginal and average cost equals one, and cost minimization so that  $w_i = f_i$  for all  $i$ . Assume the isoquants are strictly convex, and at least some of each factor is needed to produce any output. The linear homogeneity assumption guarantees that one can calculate the nature of possible variations in factor price compatible with these assumptions by considering only one isoquant. Using vector notation, consider two such compatible factor price vectors,  $W_0$  and  $W_1$ , and their associated minimum cost factor inputs,  $X_0$  and  $X_1$ . We know:

$$(1) \quad \min_X W_0 X = W_0 X_0 = 1 < W_0 X_1$$

$$(2) \quad \min_X W_1 X = W_1 X_1 = 1 < W_1 X_0$$

Thus:

$$(3) \quad W_0 X_0 < W_1 X_0 \quad \text{or} \quad W_0 \succ W_1$$

and

$$(4) \quad W_1 X_1 < W_0 X_1 \quad \text{or} \quad W_1 \succ W_0$$

That is, neither factor price vector, compatible with the assumptions, can be strictly greater than the other. If one observes two such systems of factor prices, if one of the components of one is greater than the same component in the other, some other component must be less.

<sup>12</sup> Denison's study [3] of U. S.-European productivity differences identifies a large number of factors, but also a significant "total factor productivity" difference. Anne Krueger's unpublished study of U. S.-Indian productivity differences [9], while concluding that capital and education are a lot of the story, also has an unexplained residual.

portant measurement errors that need to be treated. But the point that will be stressed in the remainder of this paper is that there are no reasons why the two basic assumptions of the model—a common linear homogeneous production function and perfect competitive factor markets—should be held sacrosanct.

## II. *The Case for Abandoning the Basic Assumptions: Manufacturing Development as a Diffusion Process*

The assumptions of a common production function, and perfect and competitive factor markets, have proved both convenient and fruitful for modeling many economic phenomena. However, they would appear to get in the way of understanding international differences in productivity—particularly differences between advanced and underdeveloped economies.

It has been clear for some time that growth and structural transformation of the manufacturing sector in advanced economies is, in considerable part, the result of technological advance and not simply the result of increases in the various factors of production. Because of the accounting identity between the value of output and the returns to inputs, it always is possible to “explain” output changes by input changes (suitably measured); however many of these input changes themselves must be attributed to technological advances. Technological advance itself probably can be attributed in some part at least to inputs invested for the purpose of advancing technology, hence in some sense perhaps changes in output can be attributed to changes in inputs (although the relationship almost certainly will not be linear homogeneous). However, no one would deny that in advanced countries in a quite fundamental sense production functions have changed and are changing over time. While this is a statement about growth over time within a country, it has important implications regarding differences, at any moment of time, across countries.

Recent research by Donald Keesing, Raymond Vernon, G. C. Hufbauer,<sup>13</sup> and others, suggests strongly that trade patterns in manufactured products reflect more than differences in resource endowments. A considerable portion of U.S. manufacturing exports is in new products that other countries have not yet begun to produce in quantity. Vernon and Hufbauer go on to show that, with a lag, the other major manufacturing nations pick up and employ U.S. technology (and gradually cut the United States out of export markets). With a greater lag, eventually less developed countries begin to adopt and employ the technology (if it has not already become obsolete).

<sup>13</sup> See references [8], [21], and [7], for an introduction to a rapidly growing literature.

The theory of technological lead and product cycle suggests a quite different analysis of international differences in productivity than is implied by the model discussed in the preceding section. The engine of manufacturing development is technological advance in the developed countries—particularly the United States. While the fact that the United States is the leading country in creating new products can, at least partially, be attributed to its “endowments” of managers, scientists, engineers, and just plain innovative and flexible people, it is clear that the United States has a real technological “lead.” More generally, the position of any country in the diffusion hierarchy may well be a function of factor endowments, particularly supply of sophisticated managers, technicians, and easily trainable labor. But there is no reason to believe that these factors enter in the way that one would try to force them to enter the analysis if one followed the conventional approach. For viewing the economic development process as a diffusion process naturally leads one to abandon the two basic assumptions of the neoclassical model—that all firms in all countries are on the same production function, and that markets are in full equilibrium.

Within the country where the inventing is going on, the firms doing it have at least a potential head start over the others. Other firms may themselves have been close to making the invention, and be able to follow quite quickly. Other firms may lag considerably. Within the adopting countries, firms may differ greatly in their ability to adopt quickly; some may be subsidiaries of the innovating firms in the countries doing the inventing, and among the domestically owned firms there may be great variation in technical and managerial capability to adopt new technology. Various studies of diffusion show that in general it takes a considerable time for a new technique to spread to most of the firms in an industry. Thus at any given time one would expect to find considerable variation among firms with respect to the vintage of their technology, certainly between countries, but even within a country.<sup>14</sup>

Variation among firms with respect to vintage of technology is certainly compatible with perfect factor markets. The Solow embodiment model and various versions of the putty clay model,<sup>15</sup> for example, involve both differences among firms in the vintage of their technology, and perfect factor markets. But such models require perfect knowledge and foresight on the part of firm managers, and perfect knowledge and mobility on the part of factors. The studies of diffusion, while consistent with the assumption that entrepreneurial decisions move the systems in the direction of equilibrium, do not indicate that the adjustment rate is so rapid that, for all practical purposes, all firms always have the same

<sup>14</sup> For a survey of the diffusion literature see Nelson, Peck, and Kalachek [12, Ch. 5].

<sup>15</sup> See Solow [17] and Salter [16].

rate of return on capital. Clearly they don't. Similarly, the various studies of labor mobility, while indicating that labor moves from poorer to better paying jobs, far from indicate a perfect labor market.<sup>16</sup>

It would appear, therefore, that data on value added per worker in a particular industry represent the weighted average of a distribution that may have considerable range and variance.

$$(13) \quad \frac{Q}{L} = \frac{\sum_{(Q/L)_{\min}}^{(Q/L)_{\max}} \left( \frac{Q}{L} \right) L_i}{(Q/L)_{\min}} \frac{L_i}{L}$$

Comparing less with more developed countries it is clear that  $(Q/L)_{\max}$  is likely to be smaller in the former both because of differences in factor prices and because some firms in the more developed countries, where the inventing is going on, are simply ahead technically. And  $(Q/L)_{\min}$  is likely to be smaller in the less developed country, for factor price reasons if for no other.

It also is likely (although far from certain) that the range of productivity will be greater in the less developed country. There are two basic reasons. First, the responsiveness of investment to a new, even highly profitable, technological opportunity, although positive, is likely to be less strong. Managerial talent is more limited and it is likely that differences in management capabilities show up more sharply in ability to appraise and exploit new opportunities than in any other way. There are likely to be more in the way of specific input bottlenecks—particular skills, and machinery that must be purchased from abroad. Second, imperfect domestic factor markets, another well-known characteristic of less developed countries, further tend to slow the adoption process by increasing the cost of expanding firms. Slow adoption not only reduces the density of the distribution in equation (13) at the top; it also reduces pressure on lagging firms. Slow adoption, in Sidney Winter's terms, makes survival space less constraining.<sup>17</sup>

To develop a sophisticated fully articulated model to formalize the kinds of relationships discussed above probably will prove to be a major task. While I think the game is worth the candle, I cannot undertake it here. However, it is possible, and seems worthwhile, to illustrate how some of these relationships work by the following highly stylized and simplified model.

Assume that initially at time  $t_0$  full competitive equilibrium exists on product and factor markets, all firms have the same (linear homogeneous) production functions and (within any country) face the same factor prices, have the same costs, and are making a normal profit. Any initial

<sup>16</sup> Nelson, Peck, and Kalachek [12, Ch. 5 and 7].

<sup>17</sup> Winter [22].



differences in output per worker across countries will then be a function of relative factor endowments which in turn will be reflected in relative and absolute factor prices. To simplify matters assume that capital and labor are the only factors (one can interpret capital as broadly as one wishes): Thus at time  $t_0$ :

$$(14) \quad \left(\frac{Q}{L}\right) = f\left(\frac{K}{L}\right) = g(w, r)$$

where  $g(\cdot)$  is homogeneous of degree zero.

Assume that at time  $t_0$  a new technology is invented that is  $\alpha$  times more productive for every factor mix.<sup>18</sup> At time  $t_0 + \theta$  the new technology is first brought into use at a level comprising  $\epsilon$  per cent of total output. The lag between invention and introduction,  $\theta$ , may differ across countries. After time  $t_0 + \theta$  productivity will be:

$$(15) \quad \left(\frac{Q}{L}\right) = g(w_1, r_1) \frac{L_1}{L} + \alpha g(w_2, r_2) \frac{L_2}{L}$$

In the formulation above, the subscript (1) refers to the old technology and the subscript (2) to the new technology.<sup>19</sup> For heuristic reasons, and to link the model of this section with the empirical analysis of Section III, I shall call the new subsector "modern" and the old subsector "craft." The use of the subscript for factor prices indicates that factor prices may differ for firms using the two technologies, although they are assumed equal initially.<sup>20</sup>

Unit costs for the two technologies will be:

$$(16) \quad \begin{aligned} C_1 &= h_1(w_1, r_1) \\ C_2 &= h_2(w_2, r_2) = \frac{h_1(w_2, r_2)}{\alpha} \end{aligned}$$

<sup>18</sup> The assumption that the new technology is neutrally better than the old is very bothersome. For a number of reasons I would like to assume that the new technology is capital using relative to the old, but this proves more complex mathematically.

Even more important, I would like to be able to introduce a "learning" phenomenon, with the necessity for time elapsing or experience accumulating before the productivity advantages of the new technology are fully realized. For an example of a possible treatment see the appendix to [13]. But again, for this preliminary explanation, the costs of added complexity seem too high.

<sup>19</sup> The intra-manufacturing dualism model obviously has a kinship with the Ranis-Fei agricultural-manufacturing dualism model [15]. Houthakker has an interesting distribution of firms model in which, like in the present one, looking at the aggregate obscures what is really going on [6].

<sup>20</sup> Equation (15) would appear to introduce a logical inconsistency into the model, for the  $g(\cdot)$  expression assumes perfect and competitive factor markets, and equation (18) explicitly denies it. As with the oversimplifications of this preliminary model, this can be remedied, but with an undesirable increase in complexity. Instead the apparent inconsistency will be resolved by assuming that while the factor market is not perfect between the two classes of firms, it is perfect within each class.

$h_i(\cdot)$  is a linear homogeneous function of factor prices.<sup>21</sup> It is assumed that, initially, price is equal to  $C_1$ , and hence exceeds unit cost using modern technology.

Instead of assuming full equilibrium throughout the diffusion process, assume rather that the system moves toward equilibrium. Let the rate of expansion (or contraction) of output from a particular technology be proportional to unit profits (or losses).

$$(17) \quad \left(\frac{\dot{Q}}{Q}\right)_i = \lambda[P - h_i(w_i, r_i)] \quad \lambda > 0$$

$$Q_1 + Q_2 = Q$$

Assume that profitable (and expanding) firms have to pay more for their factors than firms breaking even or losing money (and hence declining). Without specifying at the moment the relative (dynamic) elasticities of supply of the two factors, let the cost equations be:

$$(18) \quad h_i(w_i, r_i) = h_i(\bar{w}, \bar{r}) + b(P - h_i(\bar{w}, \bar{r}))$$

$$0 \leq b < 1$$

where  $\bar{w}$  and  $\bar{r}$  are the factor prices firms just breaking even have to pay, and  $b$  is, in a sense, a "sharing" factor determining the split of rents between profits and factor payments. There may or may not be a trend in  $\bar{w}$ ,  $\bar{r}$ . Like  $\theta$ ,  $\lambda$  and  $b$  may differ across countries.

Finally, let the demand equation be:

$$(1a) \quad P = P(Q) \quad P' \leq 0$$

As we shall see, either a positive trend in factor prices or a downward sloping demand curve provides the required squeeze on the profitability of "craft technology."

It is easy to see that in the new equilibrium  $(Q/L)$  equals  $(Q/L)_2$ ,  $P$  equals  $h_1(\bar{w}, \bar{r})/\alpha$ , and craft technology is completely eliminated. If  $\bar{w}$  and  $\bar{r}$  change, this too, of course, would be reflected in the new equilibrium. In any case real factor returns, in terms of the good in question, will be higher in the new equilibrium. All this is obvious.

What is interesting about the model is what it tells us about the path to the new equilibrium, and characteristics of the industry along the path.

The relative importance of the craft and modern technology will be

<sup>21</sup> A linear homogeneous production function plus cost minimization imply a cost function linear homogeneous in factor prices.

changing as follows:<sup>22</sup>

$$(19) \quad \frac{d}{dt} \log \left( \frac{Q_2}{Q_1} \right) = \lambda(1 - b) \left( 1 - \frac{1}{\alpha} \right) h_1(\bar{w}, \bar{r})$$

The rate of growth of  $Q_2$  relative to  $Q_1$  will be greater, the greater is  $\lambda$ , the smaller is  $b$  (the sharing factor), and the greater the efficiency advantage of new technology over old. If we assumed no change in  $\bar{w}$  and  $\bar{r}$  and plotted  $Q_2/Q_1$  over time the curve would be S shaped; specifically, it would be a logistic.

$$(20) \quad \frac{Q_2}{Q_1} = - \frac{1}{1 + \left( \frac{Q_1}{Q_2} \right)_0 e^{-ct}}$$

where 
$$c = \lambda(1 - b) \left( 1 - \frac{1}{\alpha} \right) h_1(\bar{w}, \bar{r})$$

All these conclusions are consistent with what we know about diffusion patterns.<sup>23</sup>

As the diffusion process proceeds, productivity will be rising. If we assume that profitable firms pay either the same factor prices or more for both factors in the same proportion, then noting that  $g(\cdot)$  is homogeneous of degree zero, the productivity equation has the simple form:<sup>24</sup>

$$(15a) \quad \frac{Q}{L} = g(\bar{w}, \bar{r}) \left[ 1 + (\alpha - 1) \frac{L_2}{L} \right]$$

$$\begin{aligned} \frac{d}{dt} \log \left( \frac{Q_2}{Q_1} \right) &= \left( \frac{\dot{Q}_2}{Q_2} \right) - \left( \frac{\dot{Q}_1}{Q_1} \right) = \lambda \left[ h_1(r_1, w_1) - \frac{h_1}{\alpha}(r_2, w_2) \right] \\ &= \lambda \left[ (1 - b) h_1(\bar{r}, \bar{w}) - (1 - b) \frac{h_1(\bar{r}, \bar{w})}{\alpha} \right] \\ &= \lambda(1 - b) \left( 1 - \frac{1}{\alpha} \right) h_1(\bar{r}, \bar{w}) \end{aligned}$$

<sup>22</sup> For a survey see Nelson, Peck, and Kalachek [12, Ch. 5]. Equation (20) is derived once one notes that

$$\frac{Q_2}{Q_1} = \frac{1}{1 + \frac{Q_1}{Q_2}} \quad \text{and} \quad \frac{Q_1}{Q_2} = \left( \frac{Q_1}{Q_2} \right)_0 e^{-ct}$$

$$\frac{Q}{L} = g(w_1, r_1) \frac{L_1}{L} + \alpha g(w_2, r_2) \frac{L_2}{L}$$

But if  $w_i/r_i = \bar{w}/\bar{r}$  then  $g(w_i, r_i) = g(\bar{w}, \bar{r})$ . Noting that  $L_1/L = 1 - L_2/L$  equation (15a) follows.

But under these assumptions, since  $Q_2/Q$  is a logistic so is  $L_2/L$ .<sup>25</sup> Therefore the time path of productivity will also be a (shifted upwards) logistic with slow growth initially, then acceleration, and finally a slowing down of the rate of productivity growth as new technology becomes dominant. And under these assumptions productivity growth would be strictly due to growth of total factor productivity. With a constant  $\bar{w}$  and  $\bar{r}$ , and the same factor price ratios facing both groups of firms, there would be no change at all in the industry capital-labor ratio.

More realistic assumptions about the factor cost adjustment equations blur the neatness of the above result. For example, it seems reasonable to assume that while the expanding (and profitable) firms have to pay more for labor, they may have no disadvantage at all relative to less profitable firms in gaining access to capital. In this case firms employing new technology would have a labor productivity differential over firms using the older technology that exceeds  $\alpha$ , reflecting the higher wage to interest rate ratio they face. In this case, of course, the productivity growth equation is much more complicated, nor can it any longer be assumed that  $L_2/L$  and  $Q_2/Q$  move in lock step. But the simpler result is quite suggestive.

The diffusion period would be marked by a high capital share, where the returns to capital are defined to include quasi rents, as well as interest. During the diffusion process positive quasi rents would be made by the modern subsector (and pulling its expansion), negative quasi rents by the craft subsector (and stimulating its contraction), but the former would outweigh the latter. Letting  $r$  stand for the average interest rate, capital's share would be:<sup>26</sup>

$$\frac{L_2}{L} = \frac{1}{1 + \frac{L_1}{L_2}}$$

but

$$\frac{L_1}{L_2} = \frac{\left(\frac{Q_1}{L_2}\right) Q_1}{\left(\frac{Q_1}{L_1}\right) Q_2} = \left(\frac{Q_1}{Q_2}\right)$$

Thus  $L_2/L$  is the same function as  $Q_2/Q$ , except for a different constant before the exponential term.

$$\begin{aligned} 1) \quad S_K &= \frac{PQ - w_1 L_1 - w_2 L_2}{PQ} \\ &= \frac{PQ - C_1 Q_1 - C_2 Q_2 + r_1 K_1 + r_2 K_2}{PQ} \end{aligned}$$

(using 16)

$$(21) \quad S_K = \frac{rK}{PQ} + \frac{\dot{Q}/Q}{P\lambda}$$

Notice that quasi rents (the second term of equation 21) will be largest when output growth is most rapid, and will be negatively related to  $\lambda$ .

Thus far I have assumed that  $\bar{r}$  and  $\bar{w}$  do not change. It is interesting to augment the model with a (admittedly somewhat *ad hoc*) mechanism that would generate a change. Assume, as earlier, that capital markets are more perfect than labor markets, but now assume in addition that there is a ratchet effect in the labor market. Workers entering the modern subsector are able to force up  $\bar{w}$ , as well as receive wages temporarily higher than  $\bar{w}$ . This could be the result of an increase in net demand for labor by the industry generally (which would occur if the product demand curve were elastic), or the formation of strong unions perhaps backed by government legislation, or both. Note that the high quasi rents of the modern subsector, during the diffusion process, provide room for this to occur without causing losses, although, of course, the result would be a smaller growth of output and decline of price over the diffusion period. Note also (from equation [19]) that such a process would actually speed up diffusion by putting more pressure on the craft subsector.<sup>27</sup> Thus one might assume

$$(22) \quad \frac{d}{dt} \bar{w} = Z \left( S_K - \frac{rK}{PQ} \right) \quad Z' > 0$$

If we assume that  $\bar{r}$  does not change, this mechanism will induce a rise in the capital-labor ratio. The resulting increase in output per worker would augment that due to growth of total factor productivity. But the growth in the capital-labor ratio would itself be the result of the dynamics of the diffusion process.

The above model is highly oversimplified and in many ways misspecified.<sup>28</sup> However, it does seem to capture the spirit of a diffusion

$$\begin{aligned} &= \frac{rK}{PQ} + \frac{(P - C_1)Q_1/Q + (P - C_2)Q_2/Q}{P} \\ &= \frac{rK}{PQ} + \frac{\dot{Q}_1/Q_1}{P\lambda} \cdot \frac{Q_1/Q + \dot{Q}_2/Q_2}{P\lambda} \cdot \frac{Q_2/Q}{P\lambda} \\ (from\ 17) \quad &= \frac{rK}{PQ} + \frac{\dot{Q}/Q}{P\lambda} \end{aligned}$$

<sup>27</sup> Thus in the model the sometimes alleged phenomenon that an increase in factor costs stimulates more rapid diffusion obtains. See Habakkuk [5] for example.

<sup>28</sup> First, as mentioned earlier, the assumption that new technology is neutrally better than

point of view with respect to international productivity differences, and it certainly generates some interesting implications regarding differences between less and more developed countries.

Consider two countries that long ago had roughly equal output per worker and factor prices. Now one is "highly developed" in the sense that the diffusion process started a long time ago ( $\theta$  is small) and is complete or nearly complete (large  $\lambda$ , small  $b$ ), the other "under developed" in that the diffusion process started only recently (large  $\theta$ ) and which is characterized by a small  $\lambda$  and a large  $b$ . Assume the product is traded internationally and world prices obtained in both countries, and that  $\bar{r}$  is roughly the same in both countries because of international capital mobility. Productivity per worker would be higher in the more developed country. So would be  $\bar{w}$  and the capital-labor ratio. Part of the productivity and wage difference would reflect the higher capital-labor ratio, but the difference would be greater than the capital-labor ratio difference could explain and this would show up when the factor price frontier was considered. If the elasticity of substitution between capital and labor was not greater than one, the wage share would be higher in the more developed countries. An econometrician fitting a CES would ascribe the reason to be a less than unitary elasticity of substitution, but a large share of the difference would not be due to that but to the existence of large quasi rents in the less developed country. If one disaggre-

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old is very bothersome. There is considerable reason to believe that technology invented in the high-wage countries is labor saving. Perhaps this could be handled by having the shift factor be a function of factor prices, thus  $\alpha(w/r)$ ,  $\alpha' > 0$ . This would imply (as seems reasonable) that new technology has less of a cost-saving advantage in low-wage than high-wage countries. In addition, one would like to incorporate some kind of a learning function.

Second, the assumption (implicit) of independent national markets should be relaxed. One effect of some countries introducing the new technology earlier may be to exert downward pressure on price in the other countries as well. This modification, perhaps, could be handled by introducing a shift factor to the demand curve.

Third, the assumption of the same  $\lambda$  for expanding and declining firms, or more generally that of a "portional" adjustment mechanism should be dropped and replaced by a more sophisticated relationship.

Fourth, for many purposes one would want to drop the assumption of just two competing technologies and consider a steady flow of new technology. Formally this is not hard to do. But the resulting complication of the model appears to make drawing of sharp implications very difficult.

Fifth, the model would be significantly enriched by a more explicit modeling factor market, in particular, analysis of the determinants of  $\bar{w}$  and  $\bar{r}$ . One might want to relate movements in  $\bar{w}$  to shifts in demand for labor relative to supply domestically, and perhaps, assume  $\bar{r}$  is constant and equal in old countries reflecting international capital mobility. But if one were to go in this direction one would have to be more explicit about the factor demand implications of the profit pull adjustment equation (17). Probably one would want to pose equation (17) explicitly in terms of incremental demand for factors as a function of differences between their marginal value product and their price. This, as the modification above, seriously complicates the model.

gated, one would find that a key factor explaining the productivity differentials would be the existence in the less developed countries of a large subsector of firms using older technology, which had been largely eliminated in the more developed countries. One also would find a "dual" wage structure in the less developed country.

In short, the model seems capable of explaining quite easily certain phenomena that the neoclassical model has trouble with. It also generates some other specific implications of considerable interest.

### III. *A Colombian-U.S. Comparison*

The ideas presented in the preceding section can be made more concrete, and evidence provided to support them, by examining in detail some of the differences between the United States and Colombia in value added per worker in manufacturing as a whole, and in the various two-digit manufacturing industries.<sup>29</sup>

As reported earlier, in 1964 labor productivity in Colombian industry averaged about one-quarter that of the United States. This was roughly the same ratio as obtained in 1958 and it will be convenient to orient the discussion around 1958 data. The year 1958 provides a vantage point from which one can look forward as well as backwards. Table 2 presents comparative data by industry.

These are the kinds of observations the model discussed in Part I above purports to explain. But Table 2, which shows great variation in productivity among firms within an industry—particularly between large and small firms—suggests that the model is inapplicable. Its "representative firm" implication is clearly violated. I want to argue that a diffusion, evolution point of view is much more consistent with the data. And the relatively simply "two technologies" version can carry one pretty far.<sup>30</sup>

Colombia's recent economic history certainly reads as if it was generated by a "two technology" diffusion process. With the exception of a few industries (textile mill products and certain parts of the food processing industry) Colombia's adoption of modern technology did not really begin until after World War II. This did not mean that Colombia had no firms in other industries. In 1944 about 135,000 people were employed in Colombian industry, and there were a number of firms in almost all industries.<sup>31</sup> However, it would appear that most of these firms were craft or semi-craft, producing for a local or regional market and

<sup>29</sup> For a more complete analysis see Nelson [13].

<sup>30</sup> The following presentation should be clearly recognized as an attempt to establish the reasonableness and heuristic utility of a point of view, without doing violence to the data, rather than an unbiased weighing of evidence pro and con.

<sup>31</sup> See United Nations [20].

protected by high transport cost and the absence of a modern distribution system generally. In the early postwar period many factors, including the improvement in transport, the import shortage experience of World War II, and the ready availability of foreign exchange due to good coffee prices, increased the perceived profitability of establishing modern industry. The resulting wave of industrialization was superimposed upon the traditional structure of craft industry.<sup>32</sup>

By the mid-1950s, when coffee prices broke and industrial growth slowed until it was refueled by foreign credit, most Colombian industries contained two roughly separable groups of firms. One group, generally newcomers or old firms that had transformed themselves, consisted of firms that were roughly similar to typical firms in the same industry in more developed countries—somewhat smaller, with somewhat lower value added per worker, capital per worker, and labor quality—but using roughly the same kind of technology and recognizable as the same kind of animal. The other group was composed of the traditional small craft firms using significantly less in the way of modern equipment, and quite different (and less related to formal education) skills, and creating a far lower value added per worker. To a considerable degree these two groups differed in terms of their product. Within the so-called metal products industry the craft firms produced pots and pans, the more modern firms produced some parts for and assembled washing machines and refrigerators. But in many cases there was more direct competition. Craft firms produced shoes and furniture largely by hand or with simple power tools; modern firms produced similar products using much more power equipment and mass production organization of work. But in either case, both craft firms and more modern firms were included in almost every two- or three-digit industry, and it is the differences across countries at the two- or three-digit level that so much recent research has sought to explain.<sup>33</sup>

In part the survival of a significant craft sector in Colombia, but not in a more developed country, can be explained by neoclassical considerations. The differences between modern and craft technology do not appear to be neutral; the former is much more requiring of capital and skilled labor than the latter. Thus, craft technology is economically more viable in a country where unskilled and uneducated workers are cheap relative to educated workers and capital.

But a good part of the explanation seems consistent with the “diffusion” model rather than the neoclassical model. The late start is clear.

<sup>32</sup> For a discussion of the industrialization process in the early and mid-1950s, see United Nations [19], and Currie [2].

<sup>33</sup> See C. Díaz-Alejandro [4], and Staley and Morse [18], for evidence of dualism in other less developed countries.



TABLE 2—VALUE ADDED PER WORKER BY FIRM SIZE AND INDUSTRY, UNITED STATES AND COLOMBIA, 1958<sup>a</sup>  
(in 1958 \$U.S.)

Industry	Firm Size (employees)						
	Average Value Added	1-9	10-19	20-49	50-99	100-249	250+
United States							
Food	\$10,321	\$ 8,326	\$ 7,859	\$ 8,753	\$ 9,979	\$10,277	\$11,691
Tobacco	16,733	4,833	2,886	7,038	6,286	7,404	19,338
Textiles	5,387	8,842	7,017	6,038	5,562	5,549	5,172
Clothing & footwear	5,086	8,853	6,922	5,386	4,659	4,424	4,878
Lumber	5,465	4,330	4,252	5,308	5,855	6,117	6,265
Furniture	6,759	6,788	6,449	6,477	6,627	6,521	7,144
Paper & paper products	10,276	7,979	4,479	7,793	8,704	9,588	11,237
Printing	9,169	8,100	7,798	8,329	8,883	9,362	9,962
Chemicals	17,550	12,126	12,474	13,333	14,387	16,776	19,189
Petroleum	14,096	14,108	13,561	12,454	12,033	17,408	13,773
Rubber products	9,420	8,143	7,741	8,112	8,009	8,167	10,157
Leather products	5,436	7,235	5,883	5,532	5,388	5,234	5,442
Minerals, non-metallic	9,979	8,757	8,620	8,894	8,634	10,627	10,763
Basic metals	10,646	7,866	7,495	7,726	8,697	8,877	11,185
Metal products	8,896	8,308	8,038	8,234	8,642	8,878	9,320
Machinery, excl. elec.	9,191	8,852	8,326	8,816	9,032	9,208	9,351
Electrical machinery	9,263	8,114	7,930	8,067	8,038	8,421	9,551
Transportation equipment	9,811	7,727	7,553	8,082	8,110	8,418	10,002
Other	8,320	7,500	6,777	6,735	6,581	7,189	9,432

Industry	Average VA	1-9	10-19	20-49	50-99	100-199	200+
Colombia	\$ 2,029	\$ 1,019	\$ 1,177	\$ 2,177	\$ 2,330	\$ 3,526	\$ 2,837
Food	5,187	1,308	1,519	2,053	6,019	7,124	4,826
Beverage	7,153	416	556	986	2,971	12,243	17,575
Tobacco	1,967	560	1,282	1,105	1,363	1,436	2,174
Textiles	826	600	670	720	831	960	1,414
Clothing & footwear	864	828	811	927	797	640	1,104
Lumber	890	782	684	856	975	1,028	1,511
Furniture	1,958	1,230	1,223	1,993	1,611	884	3,027
Paper & paper products	1,403	869	803	1,601	1,834	1,335	1,762
Printing	2,983	1,863	1,562	2,818	2,667	3,364	3,855
Chemicals	6,578	3,961	3,973	2,681	—b	—b	7,105
Petroleum	2,185	1,047	1,475	1,256	1,403	—b	2,335
Rubber products	1,379	838	1,020	1,029	832	1,018	2,433
Leather products	1,276	578	679	857	1,235	1,141	2,117
Minerals, non-metallic	1,914	1,027	2,436	2,052	1,040	2,128	1,954
Basic metals	1,304	818	871	1,356	1,313	1,233	2,347
Metal products	1,172	832	943	1,105	1,076	—b	1,946
Machinery, excl. elec.	1,959	945	1,062	1,669	2,325	1,689	2,777
Electrical machinery	949	746	930	1,026	1,081	1,030	961
Transportation equipment	1,687	1,052	1,117	1,685	2,019	1,782	1,939
Other							

<sup>a</sup> Exchange rate: 6.9 pesos = 1 dollar.

<sup>b</sup> No observations reported.

Sources:

United States: U.S. Department of Commerce, *1958 Census of Manufacturers (USA), General Summary*, Washington, D.C., 1961; Colombia DANE (Central Statistical Bureau).

Shortages of skilled managers and technicians clearly limited the pace of the adoption process after it started out, and as we shall see, at least after the mid-1960s, adoption of modern technology was limited by foreign exchange.<sup>34</sup> Particularly where markets were protected from foreign competition by restrictions or transport costs, there was room in domestic demand for craft firms to survive. Finally, survival was facilitated by factor market imperfections. Minimum wage legislation and labor union organization kept wages high in the modern subsector, but did not extend effectively to small firms. Typically wage rates in large firms in an industry were three times or more those in small ones; thus small craft firms had a significant labor cost advantage.<sup>35</sup>

Let us consider various empirical implications of the dualism model. First, differences in value added per worker between the countries should be a function of the relative size (as measured by per cent of employment) of the craft subsector in Colombia. Second, reasonably well-managed firms using modern technology should be earning a very high rate of return, even when paying wage rates significantly higher than the average in Colombia (but far less than in the United States). Third, the situation in Colombia should be in flux; the modern sector should be expanding relative to the craft sector and driving it out of business in some fields.

To test any of these implications it of course is necessary to identify the craft and modern subsectors. It is reasonable that to a first approximation craft firms tend to be small and modern firms tend to be large in Colombian industry. Thus there should be much greater differences in value added per worker between small firms and large in Colombia than in the United States where, presumably, the craft sector is much less significant in relative size even among small firms. Table 2 presents the data for 1958. Data for 1964 will be presented later. Notice that in the United States, with the striking exception of the tobacco products industry (where the giant firms are highly mechanized cigarette companies and the smaller firms cigar manufacturers), while value added per worker is positively related to size, value added per worker in the giants is seldom more than 50 per cent larger than in the smaller firms. In Colombia, on the other hand, the difference in value added per worker between large and small firms tended to be substantial except in those industries, like lumber, where even the large firms had very low productivity suggesting they too were "craft." Thus the association of craft

<sup>34</sup> For a more complete discussion, see Nelson [13].

<sup>35</sup> See Nelson [13] for data. The association of "large" with modern and "small" with craft will be justified later.

TABLE 3—RATIO OF COLOMBIAN VALUE ADDED PER WORKER TO U.S. VALUE ADDED PER WORKER, BY INDUSTRY AND FIRM SIZE, 1958

Industry	Firm size (employees)						
	Average	1-9	10-19	20-49	50-99	100-199 <sup>a</sup>	200+ <sup>a</sup>
Food <sup>b</sup>	.28	.12	.15	.25	.30	.52	.33
Tobacco	.43	.09	.19	.14	.47	1.65	.91
Textiles	.37	.06	.18	.18	.25	.26	.42
Clothing & footwear	.16	.07	.10	.13	.18	.22	.29
Lumber	.16	.19	.19	.18	.14	.11	.18
Furniture	.13	.12	.11	.13	.15	.16	.21
Paper & paper products	.19	.15	.27	.26	.19	.09	.27
Printing	.15	.11	.10	.19	.21	.14	.18
Chemicals	.17	.15	.13	.21	.19	.20	.20
Petroleum	.47	.28	.29	.22	.00	.00	.52
Rubber & rubber prod.	.23	.13	.19	.16	.18	.00	.23
Leather products	.25	.12	.17	.19	.15	.20	.45
Minerals, non-metallic	.13	.07	.08	.10	.14	.11	.20
Basic metals	.18	.13	.33	.27	.12	.24	.18
Metal products	.15	.10	.11	.17	.15	.14	.25
Machinery, excl. elec.	.13	.09	.11	.13	.12	.00	.21
Electrical machinery	.21	.12	.13	.21	.29	.20	.29
Transportation equipment	.10	.10	.12	.13	.13	.12	.10

<sup>a</sup> U.S. size groups are actually 100-249 and 250 and up.

<sup>b</sup> U.S. includes food and kindred products; Colombia, food and beverage industries combined.

Source: Table 4.

with small and large with modern seems roughly valid, but not always so.<sup>36</sup>

To permit testing of the first implication, Table 3 presents value added per worker in Colombia as a fraction of that in the United States by industry and by firm size within an industry. Notice how much closer the large Colombian firms were to their U.S. counterparts in terms of value added per worker than were the small Colombian firms. In industries where value added per worker in Colombia was a relatively

<sup>36</sup> Conscience (as smoked out by Richard Cooper) requires the mention of another interpretation. The large firms in an industry tend to be able to get strong effective protection for their products, hence charge very high prices, and their high value added per worker largely reflects monopoly rents.

large percentage of that in the United States, two conditions tended to hold. First, the ratio was .4 or greater for large firms (suggesting similar technology). Second, employment in these firms comprised a large share of total employment (see Table 4). Where Colombian value added per worker was small as a fraction of that in the United States, the large Colombian firms did poorly relative to U.S. firms (suggesting that many of them were not using modern technology), or employment in large firms was a small fraction of the total in the industry, or both.<sup>37</sup>

Regarding the second implication, interviews with accountants suggest that after-tax (and adjusted for inflation) rates of net return on capital of 30 per cent or more are typical for large firms. Colombia may be one less developed country where the average rate of return on capital in manufacturing is higher than in the developed countries, but it is clear that the average rate of return is significantly lower than the rate of return in large firms.

A high rate of return in the large modern firms, together with access to credit at reasonable terms (which seems the case when there is not a balance-of-payments squeeze) would provide a strong inducement for the modern manufacturing sector to expand—the third implication of the dualism model. As mentioned earlier, the fall in export earnings greatly slowed Colombian manufacturing growth in the mid 1950s. By 1958, however, various loans permitted a new surge of intermediate and capital goods imports and industrial growth. The pattern of post-1958 growth is revealing. Firms of over 200 employees, which in 1958 accounted for about 35 per cent of employment, accounted for over 65 per cent of the increase in employment achieved by the manufacturing sector as a whole between 1958 and 1964. They accounted for roughly the same percentage of the increase in value added. These very large firms, together with those in the 100–200 employee range, accounted for about 75 per cent of the growth in output and employment over the 1958–1964 period.<sup>38</sup>

At the same time there was a significant relative decline in employment in small firms. As employment in firms of over 200 expanded from 35 to 40 per cent of the total, employment in firms of under 50 fell from 41 to 35 per cent. As the percentage of value added in large firms increased from 49 to 54, that in small firms decreased from 23 to 17.<sup>39</sup>

<sup>37</sup> Again, there is the alternative interpretation of differing degrees of protection.

<sup>38</sup> Obviously there are two phenomena at work here—entry of new large firms and expansion of existing large ones, and the expansion of firms that initially were middle size into the large firm class. The discussion above assumes that the first is the dominant phenomenon. While I cannot prove this, various pieces of evidence support that thesis.

<sup>39</sup> Again, the interpretation is that the percentage did *not* decline because the small firms grew out of their initial size class.

TABLE 4—DISTRIBUTION OF COLOMBIAN LABOR FORCE BY FIRM SIZE, 1958 AND 1964  
(per cent of totals)

Industry	Firm Size (employees)									
	1-9		10-19		20-49		50-99		100-199	
	1958	1964	1958	1964	1958	1964	1958	1964	1958	1964
Total industry	13.8	12.2	11.1	9.8	15.9	13.0	11.8	11.7	11.9	12.7
Food	23.8	23.9	14.5	13.6	19.2	15.2	16.0	11.4	10.6	12.1
Beverages	3.5	2.9	3.1	2.7	8.6	5.6	9.4	7.5	31.1	27.2
Tobacco	15.8	14.9	13.3	11.8	18.8	11.3	12.1	11.2	10.3	12.8
Textiles	2.6	2.4	2.5	2.4	5.7	6.1	4.0	4.6	6.6	5.7
Clothing & footwear	23.2	22.6	14.7	13.7	21.5	15.8	15.8	16.7	10.6	9.4
Lumber	30.1	22.7	22.9	15.3	12.9	14.0	13.2	6.6	5.8	13.4
Furniture	28.4	29.9	19.4	18.5	21.0	22.8	10.4	9.8	12.4	5.2
Paper & paper products	3.1	2.6	9.3	8.8	21.5	16.0	18.2	13.0	17.1	16.9
Printing	13.3	11.6	15.4	16.0	19.6	17.5	7.2	8.7	15.5	13.6
Chemicals	8.6	6.7	8.8	5.7	17.3	14.9	19.4	15.2	18.1	23.0
Petroleum	.5	2.7	3.3	3.3	9.2	4.6	—	5.7	—	9.4
Rubber products	1.7	1.5	5.6	2.7	5.7	8.9	2.1	4.9	—	—
Leather products	15.8	19.2	11.6	14.2	14.3	12.1	12.4	6.9	16.8	17.1
Minerals, non-metallic	14.2	13.1	13.9	10.2	16.8	13.0	8.8	11.1	13.6	10.0
Basic metals	2.4	.6	4.9	6.1	10.6	1.8	7.7	5.9	10.7	20.0
Metal products	12.2	8.5	15.0	11.6	28.3	19.3	15.1	20.6	17.9	16.3
Machinery, excl. elec.	18.5	16.5	22.1	17.5	24.7	18.9	15.8	15.8	—	6.6
Electrical machinery	10.4	5.9	11.4	9.3	21.4	12.2	21.5	15.8	8.9	16.5
Transportation equip.	15.8	12.5	12.6	13.4	15.0	11.1	9.5	13.1	6.7	10.1
Other	9.7	9.5	14.0	10.6	19.5	21.6	25.9	25.0	14.4	23.1
									35.5	40.6
									15.9	23.8
									44.2	54.1
									29.6	37.9
									78.5	78.8
									14.2	21.8
									15.2	28.0
									8.3	13.7
									30.9	42.8
									28.9	32.6
									27.8	34.4
									87.0	74.3
									85.0	82.1
									29.1	30.4
									32.7	42.5
									63.7	65.6
									11.6	23.7
									18.8	24.7
									26.4	40.3
									40.4	39.7
									16.6	10.2

Source: DANE.

Table 4 shows that these phenomena were pervasive. In most Colombian industries there was a significant increase in the percentage of employment accounted for by large firms, and a decrease in small firms. The phenomena were particularly apparent in industries like metal products, where growth of output and employment were particularly great and the percentage of employment in large firms initially was quite small.

Not only were the bulk of employment and output increases over the period accounted for by the large firms, but roughly one-fifth of the increase in value added per worker achieved over the period was the result of a shift in the composition of the work force toward the higher productivity (larger) firms and away from the small craft firms. The shift was a particularly important contributor to productivity growth in the food processing industry (about 30 per cent), tobacco products (25 per cent), lumber and wood products (productivity would have fallen without the shift), furniture (35 per cent), paper (35 per cent), chemicals (most of the total), nonmetallic minerals (30 per cent), and metal products (more than half).

In addition, productivity growth in the large (greater than 100 employees) and medium-sized (50 to 100) firms tended to be significantly greater than in the small firms; indeed, productivity in the smallest firms would appear to have declined over the period. Thus the productivity gap between large and small firms actually widened. While this breaks from the dualism model narrowly conceived, it is roughly what one might expect in a more complete analysis. Productivity growth in the large and medium size firms probably reflects three factors—a growing percentage of these firms using modern technology, a growth of experience in operation both by management and labor, and the incorporation of more modern and/or more equipment per worker in the already modernized firms. In contrast, craft technology and productivity tend to be static.

Most of the surge of expansion of employment in manufacturing and in the large firm subsector occurred between 1958 and 1962. During this period, when employment growth in manufacturing averaged over 3 per cent a year, firms of over 100 employees accounted for better than 90 per cent of the total increase. Employment in firms of under 20 workers actually fell. Since 1962 there has been a significant decline in the rate of growth of manufacturing employment, which averaged only about 1.5 per cent a year in the 1962–64 period and probably has not risen since. To a considerable degree this has been the result of a drastic decline in the rate of employment growth in large firms, which fell from about 5 per cent a year to about 1.5 per cent. At the same time employment in

the smallest firms began to expand again. During the 1961-66 period there would appear to have been a significant rise in urban unemployment, suggesting that in considerable part the resurgence of small craft firms reflects the desperate effort of people to find any kind of work.

The basic reason would appear to be the balance-of-payments bind that again closed in on Colombia after 1961, and consequent stopping of the growth of capital goods imports to permit the expansion of the modern sector. Analysis of these developments is beyond the scope of this paper. However the effects are strikingly in accord with the model.

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# PRODUCTION AND TRADE WITH TWO FACTORS AND THREE GOODS

By JAMES R. MELVIN\*

It has long been recognized that in general equilibrium situations where the number of goods exceeds the number of factors of production, the production possibility surface will not be strictly convex, and in general there will be an infinite number of production configurations consistent with any price ratio that allows the production of all goods. As P. A. Samuelson pointed out in 1953, when the number of commodities exceeds the number of factors, "... there will necessarily be flat planes and straight lines on the convex locus; and as with Ricardo, there will not be a unique tangency when the international trading ratio is exactly equal to one of these constant-cost ratios" [5, p. 7]. J. E. Meade [4], in his discussion of J. Tinbergen's paper [7], discusses this case in connection with the factor price equalization theorem. Meade seems to have been the first to recognize the nature of the indeterminacy that exists in the three-product, two-factor case. More recently W. P. Travis [8, pp. 140-43] has discussed the two-factor, three-good case and he has shown diagrammatically and algebraically that there will be an indeterminacy in production if all three goods are produced. However, while this linearity feature of the production surface when there are more goods than factors has been recognized, a method of geometrically constructing these production surfaces has not been suggested, nor have the implications of these production sets for international trade been clearly spelled out.

The ultimate object of this paper is to examine some of the well-known trade propositions for the case where there are two factors and three goods. Before doing so, however, we will present a method of geometrically deriving the production possibility surface, and in so doing some interesting properties of production possibility surfaces of this kind will become evident.

## *I. The Production Possibility Surface*

We assume that there are three goods, the quantities of which we represent by  $X_1$ ,  $X_2$  and  $X_3$ , and two factors, labor and capital, the quantities of which are represented by  $L$  and  $K$ . We can write the production functions as:

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$$(1) \quad X_1 = f_1(K_1, L_1);$$

$$(2) \quad X_2 = f_2(K_2, L_2);$$

$$(3) \quad X_3 = f_3(K_3, L_3).$$

We assume that the total amounts of capital and labor are fixed at  $\bar{K}$  and  $\bar{L}$  respectively, so that

$$(4) \quad L_1 + L_2 + L_3 = \bar{L},$$

and

$$(5) \quad K_1 + K_2 + K_3 = \bar{K}.$$

The production functions  $f_1, f_2$ , and  $f_3$  are assumed to be homogeneous of the first degree,<sup>1</sup> and each is assumed to have continuous first and second partial derivatives everywhere.

In the two-factor, two-good case, the usual method of demonstrating the shape of the production possibility curve is to begin with the isoquant maps for the two goods, construct an Edgeworth Box, and then argue that to each point on the efficiency locus there corresponds a point on the production possibility curve. If the efficiency locus is not linear, then the production possibility curve will have the usual concave-to-the-origin shape.<sup>2</sup> For the case where we have two factors and three goods, while we still have a well-defined Edgeworth Box showing the total available quantities of labor and capital, we now have to fit three commodities into this box. Fortunately this can be done in a fairly straightforward way.

In Figure 1 we have drawn the factor endowment box for some arbitrarily chosen fixed amounts of capital and labor. With  $O'$  as the origin for the first commodity, we let  $X_1^0$  be some arbitrary quantity of this commodity, and define the corresponding isoquant as  $(X_1^0)$ . This isoquant is shown in Figure 1. Now suppose we choose some arbitrary feasible point  $A$  on this isoquant and assume that production takes place at this point. This being the case, the amounts of capital and labor available for the production of the second and third commodities are represented by the box with corners  $A$  and  $O''$ . Now if we consider  $A$  as the origin for the production of commodity 2, and  $O''$  as the origin for the production of commodity 3, the efficiency locus between these two commodities can be constructed in the usual way. The curve  $ABO''$  represents such a locus.

If production of commodity 1 is actually to take place at  $A$ , then the factor price ratio,  $w/r$ , must be equal to the slope of the isoquant  $(X_1^0)$  at

<sup>1</sup> That is, each commodity is produced under constant returns to scale.

<sup>2</sup> For an ingenious method of directly relating the efficiency locus and the production possibility curve, see K. M. Savosnick [6].

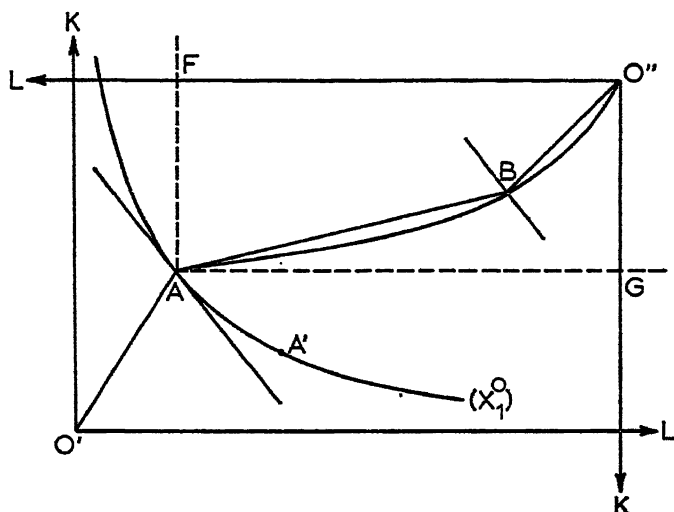


FIGURE 1

A. Now consider the production of commodities 2 and 3. For these commodities to be produced in conjunction with the production of  $X_1^O$  of commodity 1 at A we must be able to find a point such as B on the locus  $ABO'$  such that the factor price ratio at this point is equal to the factor price ratio at A. If B represents such a point, then we have found a point on the three-dimensional production possibility surface. That is, the quantities produced of commodities 1, 2 and 3 which correspond to the distances  $O'A$ ,  $AB$  and  $O'B$  respectively, give a point on the three-dimensional production possibility surface, and corresponding to this point there exists a configuration of output price ratios which would sustain production at this point.

Before proceeding several comments seem to be in order. First, there may be no point B such that the factor price ratio at B is equal to the factor price ratio at A. In other words, the production of  $X_1^O$  of commodity 1 *with the quantities of capital and labor implied by point A* need not be consistent with any point on the production possibility surface. Of course for *some* point on  $(X_1^O)$  there will be quantities of commodities 2 and 3 which will give a point on the production possibility surface. Second, if there exists a B, this point will be unique. This follows from the fact that since all production functions are homogeneous of the first degree,  $w/r$  increases monotonically and continuously as we move from A to  $O''$  along the efficiency locus. Third, B could correspond to A, in which case only commodities 1 and 3 would be produced, or B could correspond to  $O''$ , in which case only commodities 1 and 2 would be pro-

duced.<sup>3</sup> Fourth, observe that Figure 1 is symmetrical in the sense that if we had begun by choosing point  $B$  on an isoquant for commodity 3 we would have derived point  $A$ . Thus if we were to consider the factor box for commodities 1 and 2 with corners  $O'$  and  $B$ , the efficiency locus would go through  $A$ .

Now suppose we consider some other point on  $(X)_1^0$  such as  $A'$ . Corresponding to this point there will be a new  $w/r$  and there may or may not exist a  $B'$  on the new efficiency locus where the factor price ratio is the same as it is at  $A'$ . If such a point exists then we have found another

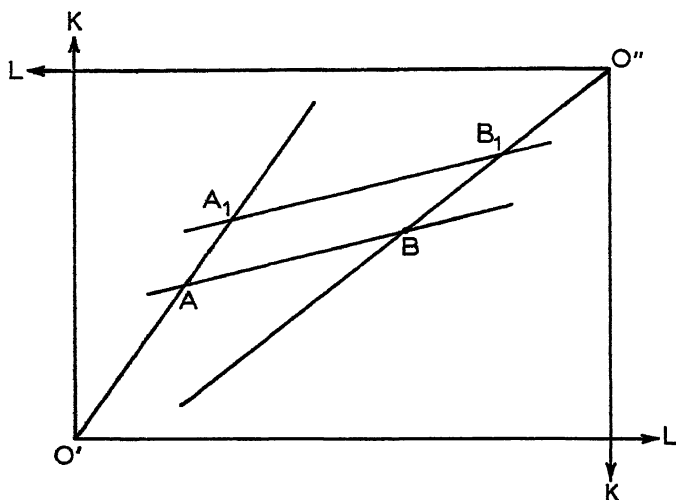


FIGURE 2

point on the production possibility surface. Certainly for a judicious choice of  $A'$  such a point will exist, and there will in general be an infinite number of such "judicious" choices, and corresponding to each there will be a distinct configuration of output price ratios.<sup>4</sup> But while we have shown the existence of an infinite number of production points, we have not yet told the whole story, for so far we have restricted our attention to the quantity  $X_1^0$  of the first commodity. We now want to consider what happens when we vary the production of commodity 1.

Figure 2 reproduces Figure 1 but omits the isoquant and the efficiency locus. Now suppose we increase the production of commodity 1 to  $A_1$ , some point further out on the factor proportions ray  $O'A$ . Now since the

<sup>3</sup> For example  $B$  would coincide with  $A$  if, with  $O'$  and  $O''$  the origins for the first and third commodities respectively, the efficiency locus for these two commodities goes through  $A$ .

<sup>4</sup> The fact that each configuration of output price ratios will be distinct follows from the fact that each point on  $(X)_1^0$  implies different factor prices and, with goods differing in factor intensities, therefore different commodity prices.

production functions are homogeneous of the first degree, the factor price ratio at  $A_1$  is the same as the one at  $A$ , and consequently the point  $B_1$  (found in the same way as  $B$  was found) will lie on  $O'B$ . Furthermore, production in the second industry will take place on the same ray from the origin as in the initial situation (since to each ray there corresponds a unique factor price ratio) and consequently  $A_1B_1$  must be parallel to  $AB$ . Thus if the output configurations corresponding to points  $A$  and  $B$  give us a point on the production possibility surface, so must the output configuration which corresponds to the points  $A_1$  and  $B_1$ , and furthermore, since no marginal conditions are disturbed in moving from  $A$  to  $A_1$ , the factor price ratio and the configuration of output price ratios will be the same for both production points. Of course the same is true for any  $A_1$  (as long as the corresponding  $B_1$  remains within the factor box) and thus there are an infinite number of output configurations all of which are consistent with a single factor price ratio and a single configuration of output price ratios. The limiting cases occur when  $B_1$  is coincident with  $O'$ , and when  $A_1$  is coincident with  $O'$ .<sup>5</sup> In the former only the first and second commodities are produced, while in the latter, only the second and third commodities are produced.

All output configurations which are possible for the single  $w/r$  assumed in Figure 2 can be represented in the three-dimensional commodity space represented in Figure 3. First consider the output configuration for the case where  $B_1$  coincides with  $O'$ . Certain quantities of the first and second commodities will be produced, and these are represented by the point  $H$ . Now let  $A$  coincide with  $O'$ . Only  $X_2$  and  $X_3$  will be produced and this production point is represented by  $J$ . It is now clear that all other outputs from Figure 2 (for a single factor price ratio) lie on the straight line joining  $J$  and  $H$ , for a small change in the output of the first commodity will always result in the same change in the outputs of commodities 2 and 3 no matter where we start, and this is just the definition of a straight line. Thus the straight line  $JH$  lies on the production possibility surface, and all production points on that line are consistent with the same  $w/r$  and with the same configuration of output price ratios. Now by changing the initial choice of  $A$ , and thus  $w/r$ , the above procedure can be repeated, and in this way all possible production points can be traced out. The production possibility surface, then, is completely described by straight lines and can be considered to be a part of the surface of some cone or cylinder.<sup>6</sup> Such a production surface is

<sup>5</sup> By "limiting cases" we refer to the points beyond which production cannot be changed without changing the factor price ratio. Note that the limiting cases described here depend on the implicit assumptions made about the relative factor intensities of the three industries, that is, on the relative slopes of  $O'A$ ,  $AB$  and  $O'B$ .

<sup>6</sup> A question of some interest is whether the surface of Figure 3 is part of a cylinder as Travis [8, p. 142] has suggested, or part of a cone. If the surface is a cylinder then all lines such as

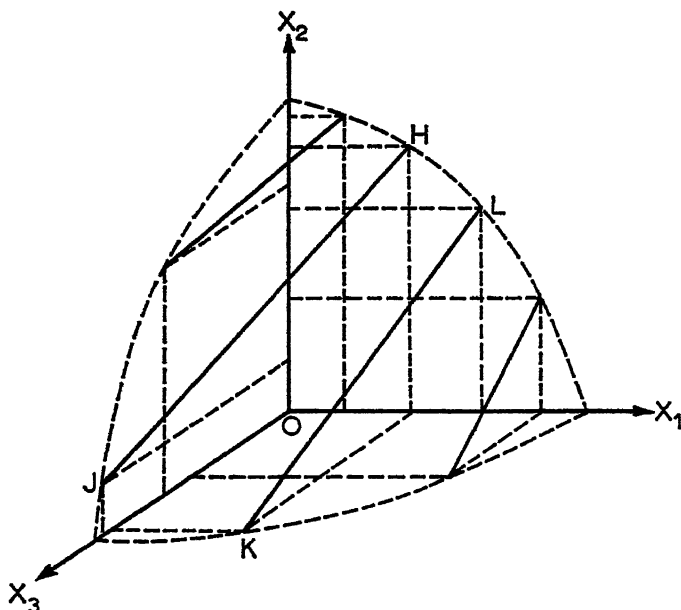


FIGURE 3

shown in Figure 3. Observe that in each coordinate plane the set of possible production points is strictly convex.

Since we want to say something about trade, we must introduce a second country. We will remain within the Heckscher-Ohlin framework by assuming that production functions in both countries are the same, and that the countries differ only in their factor endowments.<sup>7</sup> Specifically, we will assume that the only difference between the two countries is that the second country has more capital than the first.

In Figure 4 the corners of the factor endowment box for the first country are  $O'$  and  $O''$  and for the second country are  $O'_1$  and  $O''$ . Points  $A$  and  $B$  of Figure 4 are the same as the  $A$  and  $B$  of Figure 2. Now if we assume the same initial  $w/r$  for the second country as for the first, the factor proportions ray for the first commodity will have the same slope as  $O'A$ , i.e., can be represented as  $O'_1A_1$  in Figure 4. Similarly, the factor proportion rays for the second and third commodities will have the same

$JH$  and  $KL$  in Figure 3 must be parallel, or in other words no matter what initial  $w/r$  we choose, a given change in the output of one of the commodities must always result in the same change in the output of both the other commodities. Such a result is unlikely, and indeed it can be shown geometrically that arbitrary choices of production functions will result in nonparallel defining lines. We must therefore conclude that in general the defining surface is a cone.

<sup>7</sup> Since we are so far concerned with only production conditions, we need make no explicit assumptions about demand.

slopes as those in the first country, and thus they can be represented by  $A_1B$  and  $O''B$ . We could now construct a diagram for country 2 similar to Figure 3, and we would get a line on the production surface similar to  $JH$ . Now while this line would clearly be in a different place in the three-dimensional commodity space, it would have the same slope as  $HJ$ . That this is true is clear from Figure 4, for an equal change in the output of the first commodity for both countries will clearly result in an equal change in the output of the other two commodities in both countries. Of course the conclusions of the last paragraph hold for whatever initial

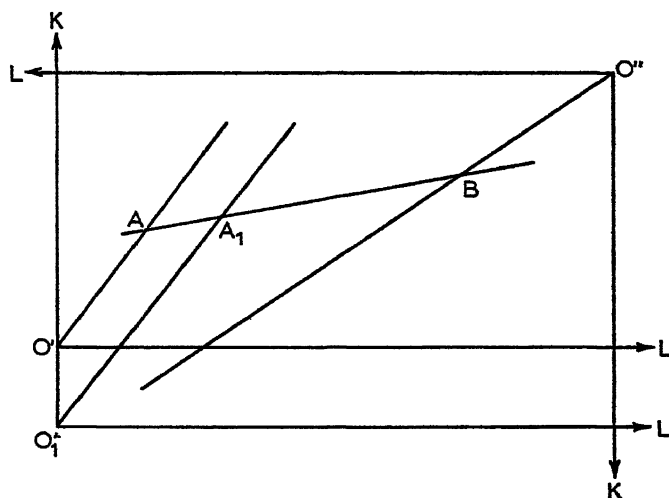


FIGURE 4

$w/r$  we choose, and thus we arrive at the important conclusion that the defining surfaces for the production possibility surfaces are independent of factor endowments and depend only on the choice of the production functions. In other words, with production functions the same, the two production possibility surfaces can be considered as pieces cut from the same cone but in different places.<sup>8</sup> As we shall see in the next section, this fact has important implications for trade between these two countries. Important questions relating to the above analysis which we must at this time put aside concern the exact relationship between the pro-

<sup>8</sup> This analysis has an interesting analogy in the two-factor, two-commodity case, for here we can consider all production possibility curves as being parts of the same curve (production functions being assumed the same). In the two-good case, however, there is a normalization problem which does not exist in the three-commodity case. For example, if two countries differ only in scale, then their production possibility curves will differ only in scale, and then unless we adjust for scale, these two curves could not both be part of a single curve. In the three-good case this problem does not exist, for to change scale we need only move closer to or farther away from the origin of the defining cone.



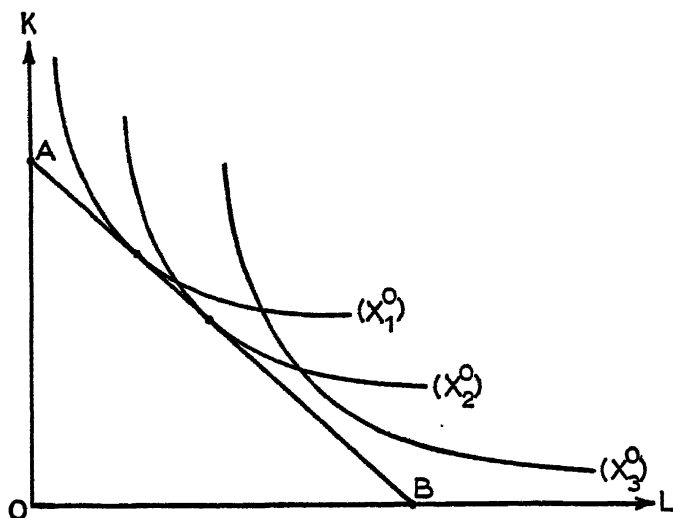


FIGURE 5

duction functions and the cone defining the production possibility surface, and in particular the position of the origin of this cone relative to the origin of the coordinate axes.

## II. *The Factor Price Equalization Theorem*

Although the factor price equalization theorem has probably received more discussion in the last twenty years than any other economic theory, there still seems to be some confusion as to what happens when there are more goods than factors. Even in treatments of the simple two-factor, three-good case, the discussions almost always leave one with a feeling of mystery as to what has gone on, and worse, the analysis is sometimes incorrect. One of the major sources of difficulty seems to be the partial equilibrium tools which are often employed. The isoquant approach, while excellent for discussions of the two-factor, two-good case, must be used with extreme care when we move to a three-commodity model. We will illustrate the problems by referring to Mrs. A. H. Land's article [3].<sup>9</sup>

Mrs. Land argues that "Where there are more than  $n$  commodities ( $n$  being the number of factors) free trade will lead each country to produce

<sup>9</sup> As we shall observe, Mrs. Land's conclusions for the two-factor, three-good case are incorrect. For earlier, correct treatments see Meade [4] and Samuelson [5]. The fact that these treatments precede Mrs. Land's article tends to indicate how slowly the Meade-Samuelson results have been absorbed by the international trade literature. The mathematical nature of these two articles is perhaps a partial explanation for this. For a recent discussion of this problem, but one that uses a somewhat different approach, see H. G. Johnson [2].

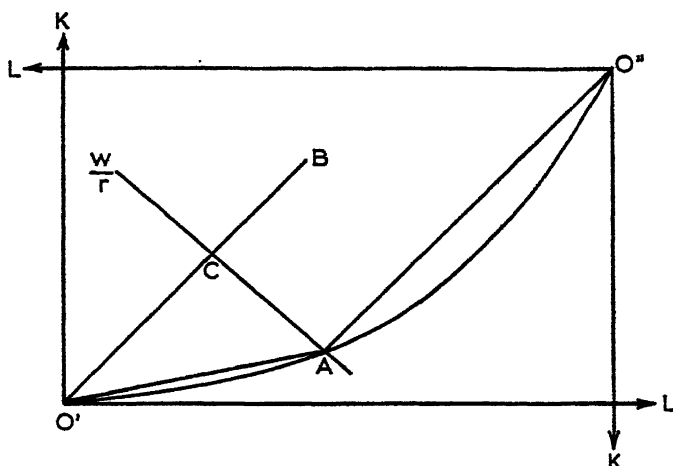


FIGURE 6

not more than  $n$  commodities, factor price equalization being achieved only between countries which happen to produce the same set of  $n$  commodities" [3, p. 140]. Mrs. Land reaches this conclusion with the following kind of argument. For the two-good, two-factor case, the equilibrium factor price ratio is the ratio which is simultaneously tangent to the unit-cost isoquants for both goods. Such a price ratio line is represented by the line  $AB$  in Figure 5, where  $(X_1^0)$  and  $(X_2^0)$  are the unit-cost isoquants for the first and second goods, respectively. Now suppose we add a third commodity, and add the corresponding unit-cost isoquant as  $(X_3^0)$  in Figure 5. Now in order for all three goods to be produced, the three isoquants would have to be tangent to the same factor price ratio line. In general, Mrs. Land argues, we would not expect  $(X_3^0)$  to be tangent to the line  $AB$ , and consequently only commodities 1 and 2 will be produced.<sup>10</sup>

Now of course it is certainly true that if we choose  $(X_3^0)$  arbitrarily it will not in general be tangent to the line  $AB$ . But the point is we are not at liberty to choose this isoquant arbitrarily, and we can in fact show that for each of the possible production points on a production possibility surface such as the one shown in Figure 3, all three unit-cost isoquants will be tangent to a common factor price ratio line.<sup>11</sup> We can demonstrate this as follows.

In Figure 6 we have a factor box for the two-commodity case where  $A$  is any point on the efficiency locus, and where  $O'$  and  $O''$  are the origins

<sup>10</sup> Or commodities 2 and 3 could be produced. In any case the country will produce only two of the three goods.

<sup>11</sup> This excludes the boundary points of this surface, and if production takes place on a boundary, then the situation shown in Figure 5 will be the expected one.

for the first and second commodities, respectively. The point  $A$  implies a particular factor price ratio, say  $w/r$ , and for this factor price ratio the factor-proportions rays for commodities 1 and 2 are  $O'A$  and  $O''A$ , respectively. Now from  $O'$  we draw the factor-proportions ray for the second commodity. This ray is represented by  $O'B$  and is parallel to  $AO''$ . Along this line all the isoquants for the second commodity have the slope  $w/r$ . We now want to know at what point along  $O'B$  we can locate the isoquant which represents the same total cost as the production of the quantity of commodity 1 produced at  $A$ . But the point we seek is obviously  $C$ , since the line  $w/r$  is a constant cost line. Thus the isoquants for the first and second commodities tangent to  $w/r$  at  $A$  and  $C$  represent the same total cost and consequently are just scaled-up versions of the unit-cost isoquants. Of course this same argument is true for any point  $A$  on the efficiency locus, and we reach the not very surprising conclusion that for each point  $A$  on the efficiency locus, the unit-cost isoquants corresponding to that point will both be tangent to the factor price ratio line implied by the point  $A$ .

We can now apply the above analysis to the three-commodity case shown in Figure 1. With  $A$  and  $O''$  as the origins for the second and third commodities respectively, the unit-cost isoquants will both be tangent to the factor price ratio line having the slope of the one going through  $B$ . Now consider  $B$  and  $O'$  as the origins for the second and first commodities respectively. As we argued earlier,  $A$  is on the efficiency locus and thus the unit-cost isoquants for commodities 1 and 2 will both be tangent to the factor price ratio line having the slope of the one going through  $A$ . But the factor price ratio line at  $A$  is the same as the one at  $B$ , and the output of the second commodity is the same whether measured from  $A$  to  $B$  or from  $B$  to  $A$ , and thus the unit-cost isoquants for all three commodities are tangent to the same factor price ratio line. Of course the same is true for all such points and thus all points on the three-dimensional production surface which allow positive production of all three goods correspond to situations where all three unit-cost isoquants are tangent to the same factor price ratio line.

The fact that each point on the production possibility surface of Figure 3 which allows the production of all three goods corresponds to a situation in which the unit-cost isoquants for the three goods are tangent to the same factor price ratio line is certainly not a surprising result, for there is clearly no other situation in which the three goods could be produced simultaneously. Nevertheless, this simple observation, taken in conjunction with the fact that in both countries the production possibility surfaces are segments of the same cone, allows us to draw some interesting conclusions about the possibility of factor prices being equalized by trade. We will suppose that before trade both countries were

producing some of all three goods, and that the output price ratios were different in the two countries. Now when we allow trade, Mrs. Land claims that each country will produce at most two goods and that factor prices will be equalized only if both countries produce the same two goods. Now in general there is no reason to expect this result. As long as the production possibility surfaces "overlap" in the sense of having some set of the defining lines in common, there is a possibility that the final equilibrium price plane will be tangent to both surfaces, in which case both countries will (or at least could) produce all three goods. Then as long as there is no factor intensity reversal, factor prices will be equalized.<sup>12</sup>

Of course the production possibility surface need not "overlap" in which case there will be specialization and factor prices will not be equalized.<sup>13</sup> But this possibility is not unique to the three-commodity case. In the two-good, two-factor case, if the production possibility curves do not have any points with a common slope, or in other words if there is no price ratio line which could be drawn tangent to both curves, then with free trade at least one country must specialize and factor prices will not be equal. In both the two-good and three-good cases, whether or not the production possibility surfaces "overlap" will depend on how different the factor endowments of the two countries are. There seems to be no reason to believe that "overlapping" is less likely in one case than in the other.

The above discussion indicates that there is no *a priori* reason for believing that there is less likelihood of factor price equalization in the three-good, two-factor case than there is in the two-good, two-factor case. We are not suggesting, however, that factor price equalization should be regarded as the expected result, for it is quite possible that in equilibrium each country will specialize in the production of two of the goods. Referring to Figure 3, the equilibrium price plane may be such that it touches the production possibility surface of one country at a point such as *J* in the  $X_2, X_3$  coordinate plane, while in the other country the same price plane touches the (different) production possibility surface at a point such as *K* in the  $X_1, X_3$  coordinate plane. For such a case, using the isoquant approach, we would have a situation such as in Fig-

<sup>12</sup> We will say more about the possibility of factor intensity reversal presently.

<sup>13</sup> It should be stressed that when we say that two production possibility surfaces "overlap" we mean that they have at least one of the defining lines in common. The two surfaces in question need not actually have points in common. In other words, if one country is much smaller than the other, the smaller one will be much nearer the origin of the cone and consequently the two production possibility surfaces may not have points in common. They may still have price ratio lines in common, however, which is all we need. We should also observe that we are not suggesting that if the surfaces "overlap," factor prices will be equalized, only that if they do not, factor prices cannot be equalized.

ure 5 where one country produces the first and second commodities with factor prices equal to the slope of  $AB$  while the other country produces the second and third commodities with factor prices equal to the slope of a line tangent to the two isoquants for these goods.

It is perhaps worth noting that if we have specialization of the kind described above, then with reference to Figure 3, one country will produce commodities 1 and 3 and the other country will produce commodities 2 and 3. Because of the way in which the surface is ruled it is not possible for one country to specialize in commodities 1 and 2 unless the other country also specializes in these same two goods, in which case

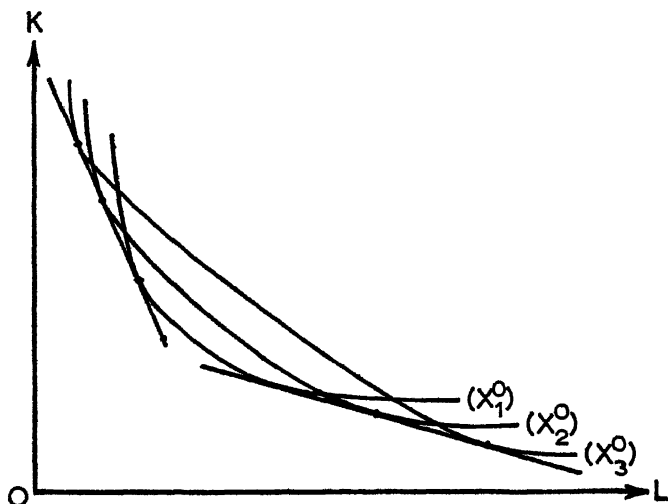


FIGURE 7

none of commodity 3 would be produced. The reason for this becomes clear when we observe from Figure 2 that commodity 3 is the intermediate good with respect to factor intensities. In terms of Figure 5 one country will not produce only the two extreme commodities, goods 1 and 3 in this case, unless they both do.

We observed above that when all three goods are produced in both countries, factor prices will be equalized as long as we do not have factor intensity reversal. We now want to observe that if all three goods are produced by both countries, factor intensity reversal implies a situation such as the one shown in Figure 7. It is clear that such a situation is an extremely special case, or as J. Chipman [1, p. 33] has suggested, must be regarded as a pathology. Thus if both countries produce all three goods, the possibility of factor intensity reversal can be ignored, and we can conclude that factor prices will be equalized.

Of course we are not suggesting that in the three-good case factor intensity reversal cannot occur, for clearly we could have a reversal for two of the goods which would in no sense be pathological. But in such a case if the reversal were relevant, i.e., if the endowment ratios for the two countries were on opposite sides of the reversal ray, then at least one of the countries would produce only two goods and we would not expect factor price equalization in any case. Factor intensity reversal is pathological only if both countries produce all three goods, but then this is the only case in which factor price equalization is to be expected.

Lest it be thought that in the above analysis we have been overly concerned with the production side, we must point out that the demand conditions are equally important in determining what the final equilibrium will be. We have suggested that in certain cases it will be possible for factor prices to be equalized. Whether they will or not will depend on demand conditions. We have on occasion assumed that in the final equilibrium all three goods will be produced, and of course this is just an assumption about demand. Indeed we can never conclude that factor prices will be equalized without taking into account the factors on the demand side.

### III. *A Fundamental Indeterminacy in Production*

The single most important factor in our discussion so far has been the nature of the production possibility surface. In particular, importance has been attached to the fact that it is a ruled surface, or in other words a surface which can be completely described by straight lines. Insofar as we are concerned with determining the production and consumption point in autarky, this characteristic introduces no difficulties, for in general we might expect there to be a unique equilibrium. For example, if the community can be assumed to have an aggregate utility function, then such an equilibrium would be defined by the point where some community indifference surface is tangent to the production possibility surface. When trade is introduced the situation is different, however, and in general we can expect that there will be an indeterminacy in production. The nature of this indeterminacy can be seen more clearly by examining Figure 8.

In Figure 8 the price plane  $ABC$  is assumed to be the final after-trade equilibrium price configuration. This price plane is tangent to the production surface along the line  $JH$ , and the final consumption point is assumed to be  $T$ , where  $T$ , of course, is on the plane  $ABC$ . For the second country we would have a similar situation. The price plane would be parallel to  $ABC$  and there would be a line  $J'H'$  parallel to  $JH$ , and a consumption point  $T'$ . Of course the relative positions of  $J'H'$  and  $T'$  will be the reverse of  $JH$  and  $T$  of Figure 8, and for trade to be balanced,



at  $M$  they can both consume at  $T$  by trading, and of course there are an infinite number of other output configurations which are consistent with both countries consuming at  $T$ . Of course we cannot be sure which of these trading positions are possible until we know how the price plane for the second country relates to the price plane  $ABC$ . For example, if the price plane for country 2 does not contain the point  $R$ , then country 2 certainly could not produce at  $R$ . Or to put the matter in terms of country 1, country 1 can produce only between  $J$  and  $H$ , even though it is possible that the price plane for country 2 may be larger than the plane  $ACB$ , and thus could contain extensions of the line  $JH$ .

The most important conclusion to be drawn from this discussion of indeterminacy is the fact that the indeterminacy in production, and thus in trade, is not just a quantitative matter, for the actual pattern of trade depends on which of the possible production configurations is chosen. For example, if country 1 produces at  $H$  and country 2 at  $M$ , then country 1 will export commodities 1 and 2 and import commodity 3. If, however, country 1 produces at  $S$  and country 2 at  $R$ , then country 1 will export commodity 3 and import commodities 1 and 2. Thus a priori we have no way of knowing whether the first country will export commodities 1 and 2, or commodity 3.

This argument brings out a further interesting fact. In the last section we observed that with respect to factor intensities, commodity 3 is intermediate, and further reference to Figure 2 shows that commodity 1 is the capital-intensive commodity while commodity 2 is labor-intensive. Thus if all goods are traded, country 1 will either export some of both the capital-intensive and labor-intensive commodities, commodities 1 and 2, or alternatively will export commodity 3, the intermediate good. Of course the same must be true for country 2; if all three goods are traded it will either export commodities 1 and 2 or commodity 3. Thus when all goods are traded, whichever country exports the labor-intensive good will also export the capital-intensive one, with the other country exporting the intermediate commodity, and furthermore we have no way of knowing which country will export the two extreme goods and which will export the intermediate one.

On first glance this observation seems rather damaging to the Heckscher-Ohlin Theorem, and indeed it is if we insist on thinking in terms of factor intensities with respect to individual commodities. The situation of Figure 8 can, however, be reconciled with the Heckscher-Ohlin model by observing that for any production point along the line  $JH$ , the proportions of capital and labor used by each of the three industries are constant. This is obvious when we recall that  $w/r$  is constant for all production points along this line, and thus all that is involved in shifting from one point on this line to another is changing the scale of production



in all three industries without changing the proportions in which the industries use the factors.<sup>14</sup> Furthermore, the consumption point, for given factor prices, can be regarded as requiring certain fixed amounts of capital and labor for its production and then the difference between a country's factor endowment and the amount of factors necessary for the production of its consumption bundle is the net amount of capital and labor embodied in trade. But both these "endowments" are constant for the situation of Figure 8 and thus for country 1, trade, no matter where it takes place along  $JH$ , essentially involves shifts in quantities of capital and labor, always in some fixed proportion. In other words, trade should be thought of as an exchange of productive capacity—a trade of one bundle of capital and labor for another—and while the size of these bundles varies along  $JH$  the proportions in which capital and labor occur in these bundles do not.<sup>15</sup>

Thus the Heckscher-Ohlin theorem is vindicated as long as we think of trade as being carried out in aggregate factor bundles. In Figure 8 for example, for country 1 no matter where along  $JH$  production takes place, the bundle of exports will contain a higher proportion of labor than the bundle of imports she receives in return.<sup>16</sup> This interpretation of the Heckscher-Ohlin theorem however, is not nearly strong enough to support many of the statements which we commonly hear or read regarding expected patterns of trade. Thus for example, statements to the effect that a certain country would be expected to export a certain commodity after trade (or after reduction of trade barriers) because this particular commodity is intensive in the factor with which the country is relatively well endowed, cannot be supported by theory in cases where there are more goods than factors. It is the total volume of trade which must be considered, not individual items.

<sup>14</sup> This is perhaps best illustrated by considering Figure 2 and recalling that moving from line  $AB$  to line  $A_1B_1$  amounts to moving from one point on a line such as  $JH$  to another. The movement from  $AB$  to  $A_1B_1$ , or any other similar movement, results in a reduction of the capital and labor used in the production of commodity 3 in the proportions indicated by the slope of  $O'B''$ , and similar adjustments in the production of commodities 1 and 2.

<sup>15</sup> Travis [8, p. 143] has also made this point. He observes that "The changes in production structure that take place along the line of tangency all imply, moreover, exactly the same pattern of trade in factor services, even though they involve different commodity-trade vectors." It should also be observed that only if there is an indeterminacy in production will one country export the two extreme commodities when all three goods are traded. For example if there is specialization such as there would be if the unit-cost isoquants are as in Figure 5, then since, as we agreed earlier, neither country will produce both extreme goods, neither can export them both.

<sup>16</sup> This can be seen by observing that if production is such that there is no trade in commodity 3 (i.e., production takes place where the line  $EF$ , which is parallel to  $AC$ , intersects  $JH$  and  $J'H'$ ) then country 1 exports commodity 2, the labor-intensive commodity, and country 2 exports commodity 1, the capital-intensive commodity. This suggests that if demand conditions are the same in both countries, country 1 is relatively well endowed with labor.

Because of the indeterminacy in production, the role of transportation takes on added significance. Insofar as transportation costs are important, we would expect there to be a tendency to choose that trading arrangement from Figure 8 which minimizes these costs. Of course there can in general be no presumption as to where this minimum will be for this will depend on the goods in question as well as how and by whom they are transported. Nor in general does there seem to be any reason to believe that the minimum will be unique. However, it does seem safe to suppose that extreme production points such as  $H$  and  $M$  will be ruled out. Thus insofar as transportation costs restrict the feasible production points, much of the indeterminacy in trade will be removed. But there is still no reason to believe that the resulting pattern of trade would be the "expected" one, for country 1 may still export commodities 1 and 2, for example.<sup>17</sup>

Because of the importance of the number of goods that will be produced, the extent to which production and trade can be considered to be regional will be important in this model. It seems unlikely, for example, that the fact that Western Canada produces hard wheat for export has much influence on trade patterns between Ontario and New York State. These considerations, of course, take us outside the scope of our three-good, two-factor model, but insofar as the indeterminacy of production carries through to higher dimensions, which seems very likely, questions concerning the relevant geographic region that should be considered when trade questions are being discussed will be important. In determining what the number of goods is, it would seem important to establish just what the relevant trading area is. Of course such questions ultimately depend on factor mobility, broadly defined, and in this area it is difficult to formulate any very general propositions.<sup>18</sup>

Insofar as indeterminacies in production and trade exist, they are likely to frustrate attempts to measure the economic variables which are important in the international sphere. If production and trade can change substantially for virtually no reason at all, as for example movements along  $JH$  in Figure 8, it will be difficult to determine which changes are exogenous and which endogenous. This may to some extent account for the difficulties that have been encountered in calculating price and in-

<sup>17</sup> This discussion of transportation costs supposes that these costs will be an important determinant of international trade patterns. In many cases this assumption is probably not appropriate. For example, when considering trade between Canada and the United States, it seems likely, at least for Canada, that intranational transportation costs are at least as important as international transportation costs. To the extent that this is the case, transportation costs cannot be expected to solve the indeterminacy problem.

<sup>18</sup> An even more fundamental problem which relates to the question of factors and goods, is just what is a commodity, or for that matter, what is a factor? Should we consider "furniture" as a commodity, or is the relevant unit a chair, say, or perhaps a particular kind of chair? Clearly being able to define a good and a factor is essential if we are going to count them.

come elasticities of demand for imports. Also, if these indeterminacies in production and trade exist, we may be able to change patterns of trade without changing prices. To the extent that this is possible and occurs we would expect to observe relative price stability in the face of substantial changes in trade patterns. And of course which prices change will be of major importance. For example in Figure 8 if there is a tendency for the price of the second commodity to rise relative to the price of the first so that the price plane rotates to the left, we might expect changes in output and trade to be relatively small. On the other hand, if the slope of  $AC$  remains constant and the tendency is for the price of the third commodity to change relative to the prices of the first and second, changes in production and trade might be substantial, for we would be moving in the direction of the indeterminacy. Thus the most important thing influencing how the quantity produced of a commodity will change when its price changes may well be how the prices of other commodities behave. Similarly the quantity produced of a commodity may change substantially when other commodity prices change even if its own price remains relatively fixed.

#### *IV. Some Further Implications*

In this concluding section we will make some very general remarks on some of the other implications of our three-good, two-factor model. First, while we have made a few passing comments on the implications for commercial policy, there are some aspects of tariff which deserve further comment. The first, and a point made by Travis, is that because of the indeterminacy in production, trade will likely be quite sensitive to tariff changes [8, p. 145]. We have already observed the implications that our model has for price changes, and since a tariff is a kind of price change, this topic need not be discussed further.

Perhaps of even more importance is the implication for other prices that tariff imposition may have. From an examination of Figure 8, it is clear that if the tariff brings about a change in the relative price of the good on which it is imposed, then if equilibrium is to be maintained, other prices must change as well.<sup>19</sup> This change in other prices may be substantial, and will depend on which good or goods are imported, and on which of these the tariff is placed.

So far our discussion has implicitly assumed that all goods are, or at least can be, traded. Now suppose one of the goods is a domestic, or non-traded good. This in general will solve the indeterminacy problem. To illustrate, suppose that in Figure 8 the third commodity is a good which

<sup>19</sup> The qualification that the tariff brings about a price change is important as we shall see presently.

cannot be traded. This being the case each country must produce the exact amount it consumes, so production must take place somewhere on the line  $EF$ , where  $EF$  is parallel to  $AC$  and consequently represents a constant amount of the third commodity for both countries. We are assuming that  $T$  will remain the consumption point for both countries. Earlier we argued that for country 1, production must take place along  $JH$ . We have now further restricted the production point to lie along  $EF$ , and thus production is now uniquely determined at the intersection of these two lines. The same argument holds for the second country.

Thus whether or not there will be an indeterminacy in trade depends not on how many goods are produced, but rather on how many goods are traded. While this may help somewhat in solving the indeterminacy problem there will probably be a good deal of difficulty in deciding which goods are tradable and which are not. Observe that just because a good is presently not being traded does not imply that it is inherently non-tradable, and this applies even if there are no tariffs. Insofar as transport costs are important, so that we want to minimize this cost, we may choose to consume at the intersection of  $EF$  and  $JH$  even if there is no restriction on trade in the third commodity. In this case, of course, even though one of the goods is not presently being traded, the indeterminacy will remain.

Observe that in the situation of Figure 8, we could have chosen any one of the three goods as the nontraded good without disturbing the equilibrium, although patterns of trade would certainly differ in each case. Now one of the ways we can restrict trade is with prohibitive tariffs, and thus Figure 8 illustrates a case in which a prohibitive tariff on any good need not affect relative prices or consumption. This result, of course, is a function of the diagram, and we can observe that if  $JH$  were shifted up closer to  $A$ , prohibitive tariffs could easily necessitate a readjustment of production and consumption. Nevertheless it would seem to be of some significance that there are situations in which a prohibitive tariff on *any* one of the commodities will have no effect on prices or aggregate consumption. Observe that this is in no sense an extreme case. It would seem to be just as likely as any other situation. It is tempting to speculate on how this might affect the traditional conclusions about the effects of tariffs, if the indeterminacy which exists here turns out to be important in cases of higher dimension.

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## WHAT IS PRODUCER'S SURPLUS?

By E. J. MISHAN\*

The term producer's surplus first appears in A. Marshall's *Principles* [11, p. 811, f.2], taking shape as the area between the competitive equilibrium price and the supply curve, a curve that slopes upward as a result of placing the firms in order of diminishing efficiency. Thus the supply curve may be taken as a curve of marginal cost<sup>1</sup> for the industry with the producers' surplus derived therefrom being in the nature of a rent attributable ultimately to the specialized factors that initially confer differential advantages on the firms employing them. Discussing the term in connection with consumer's surplus in Appendix K [11, pp. 830-31], Marshall appears to extend the term so as to comprehend all the surpluses a man derives as producer, including a "worker's surplus" arising from the sale of his personal services and a "saver's surplus" arising from the services of his capital.<sup>2</sup>

It is, of course, possible to introduce some refinement into these various forms of producer's surplus by reference to their spatial and temporal dimensions. A producer's surplus arising from the differential earnings of a special factor as between firms in a single industry is, in general, smaller than the differential earnings of the factor if instead the comparison is made between this industry and others, and this in turn is smaller than the relevant differential as between regions. As for temporal comparisons, the longer the period considered the smaller the rent—a par-

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<sup>1</sup> With commendable analytic finesse Marshall separates the rising supply curve resulting from differential advantages as between firms, "the particular expenses curve," from the possible external economies which may predominate and act, therefore, to lower the unit cost as the total output of industry is increased. The contribution of external economies are taken as fixed at the equilibrium output, *OH*, of his Figure 39 [11, p. 811]. This procedure is correct inasmuch as the area measures what the total number of firms take to be their rents or producers' surpluses. Nonetheless, since competitive firms ignore their contributions in reducing cost for all other firms, the equilibrium output *OH* will be below the "ideal" output as would be indicated by the point of equality between the demand curve and a marginal curve taken from the downward-sloping supply curve (resulting from the dominance of external economies).

<sup>2</sup> Marshall warns us that "These two sets of surpluses (i.e., consumer's surplus and producer's surplus) are not independent. . . . For when we have reduced the producer's surplus at the value of the general purchasing power which he derives from his labour or savings we have reckoned implicitly his consumer's surplus too . . ." [11, p. 831]. Regarding consumer's surplus or producer's surplus as an absolute measure of the total surplus arising from his conjuncture, the statement is correct. If, in contrast, we are concerned with a money measure of the *change* in his welfare brought about by a change in the set of prices confronting him, it becomes possible to separate the contributions to his welfare effected by changes in both factor and product prices. In this connection see Mishan [12, p. 394].

ticular instance being quasi-rent accruing to a firm's fixed capital in the Marshallian short period. But references to such refinements are incidental to the issue broached here; that turning on the validity of the concept of producer's surplus which remains in use in economics. It has been and continues to be regarded as a surplus accruing to the firm or industry, a concept commonly believed to be symmetric with, and commonly used in conjunction with, consumer's surplus. What is to be investigated then is the analytic status of producer's surplus as a tool of partial welfare analysis especially in its application to competitive industry.

Let us prepare the way by revealing an ambiguity in the conception of producer's surplus arising out of an ambiguity in the construction of the supply curve.

# I

In his *Principles of Public Finance*, Hugh Dalton derives an old-fashioned formula [3, p. 48], the ratio of the elasticity of demand to that of supply, for the burden of an excise tax on a competitive good as between buyers and sellers. This ratio is reckoned to be approximately equal to the ratio of the loss of consumer's surplus to the loss of producer's surplus. But whether this upward-sloping supply curve is relevant to the long period or short period is not stated. If, as is likely, the long-period perfectly competitive supply curve was intended, a difficulty arises. For in comparative statics a zero (Knightian) profit accrues to all equally efficient firms *ex hypothesi* both in the pretax and post-tax long-run equilibria.<sup>3</sup>

Similarly Mrs. U. Hicks, in her volume on *Public Finance* [7], after offering a formula for the loss of consumer's surplus resulting from an excise tax, goes on to say, "In practice, however, the situation will often be complicated by the fact that marginal costs are not constant; and we have therefore also to take account of the elasticity of the supply curve, and of the loss of producers' surplus . . ." [7, p. 170]. However, she, also, fails to say whether the upward-sloping supply curve in her Figure 3 is short or long-period. We may suppose, however, that it is the supply curve of a competitive industry as there is, following this analysis, a treatment of the case of monopoly.

A related but different difficulty arises in K. E. Boulding's treatment of the same problem in his *Economic Analysis* [1, pp. 772-73]. After discussing the symmetry between buyers' surplus and sellers' surplus, he

<sup>3</sup> The net long-period change in pure profit is therefore zero also. "Normal" profit cannot be other than the return on capital in the long period in which each factor, including capital, receives its normal supply price. In this long-period equilibrium there is no surplus left over for the firm, or the industry, in either situation. All added value is distributed among the factors employed.

applies the analysis to the well-known theorem that the revenue from an excise tax is less than the total loss of the combined surpluses. But the proposition in question has reference to production of goods, the supply curve being derived from the cost curves of competitive firms that combine factors in efficient proportions. Boulding's curve, in contrast, is no more than an offer curve derived from a given stock of goods.

In his classic *Econometrica* paper of 1938 H. Hotelling's explanation of the "rising supply curve SB" in his Figure 1 [8] is not altogether satisfactory. It is, he says, "... sometimes regarded as coinciding with the marginal-cost curve. Such a coincidence would arise if there were free competition among producers. . . ." However, "This condition is approximate, for example, in most agriculture." If agriculture were characterized by the Ricardian notion of applying increasing doses of labor and capital (in fixed proportions) to a given supply of land, then indeed the producer's surplus derived is equal to the Ricardian rent imputed to land. But competitive industry in manufactures is also possible in which case the supply curve is not a marginal cost curve, and the meaning of producer's surplus is again unclear.<sup>4</sup>

## II

I shall argue first that, whatever the interpretation put on it, the producers' surplus that is measured as an area above the industry supply curve is not symmetric with consumers' surplus. Second, that in the long period at least, the area above the supply curve is not an unambiguous index of gain to any person or group in the economy.

Consider carefully the nature and application of consumers' surplus. For all practical purposes it is best regarded as a partial concept. It is true that the combined effect, positive or negative, on a person's welfare of a large number of price changes could, in principle, be exactly offset either by a change in his money income, by a change in the amount of

<sup>4</sup> There are more recent examples of failure to be specific about the upward-sloping supply curve. In their recent paper on Indian Fertilizer Projects, Tintner and Patel [13] do not specify whether the supply curve is long- or short-period. They are, however, concerned in the main with shifts of the supply curve induced by altering the proportion of fertilizer to labor and land. And with constant wages any changes in producer's surplus would, indeed, reflect changes in the gross rent of land. In Harry Johnson's analysis of Customs Unions [9] nothing is said about the upward-sloping supply curves used from which the conclusions are derived. But the context of the analysis leads one to suppose that Johnson intended them to be long-run supply curves of competitive industries. As will be indicated in the following section neither construct can be used for deriving a surplus. As a final example, W. M. Corden in his 1957 paper [2] constructs a supply curve  $HH'$  in his Figure 1 from which he derives a measure of producer's surplus, but it is a supply curve for which money incomes and all prices *including* factor prices are to be held constant. Strictly speaking, this is not possible. The rise in supply price cannot take place if all factor prices remain unchanged. Even if variable factors, say labor and capital, did not change in price, the price of the fixed factor, say land, must rise.



any one good, or by a change in the amounts of several different goods.<sup>5</sup> But the fewer the number of price changes the easier it is to think in terms of a compensating money effect. In the limiting, but most practical, case of a change in the price of a single good, the value of money in which the change of consumer's surplus is measured is determined by the constancy of all prices save that under survey. In that case, the relevant area under the consumer's demand curve provides, under familiar conditions, a good measure of consumer's surplus.

In comparing producer's surplus with consumer's surplus in this limiting but practical case (in which the price of a single good or factor changes, all other prices remaining constant), the first thing to bear in mind is that, provided the so-called income effect is not zero, J. R. Hicks's "compensating variation" and "equivalent variation" [6] are but different money measures of exactly the same alteration in a person's welfare resulting from a change in the price of some good. So long as firms are explicit profit-maximizers, they are uninfluenced by welfare effects and no such distinction need therefore be maintained for producer's surplus.<sup>6</sup> The only other concept which can be measured either as a compensating variation or as an equivalent variation is that of a person's economic rent which is perfectly symmetric with, indeed is no more than an extension of, his consumer's surplus. As has been indicated elsewhere [12] economic rent can be defined to provide a money measure of the welfare change arising from a movement of factor prices

<sup>5</sup> The choice of numeraire in which to measure the welfare change arising, say, from the changes in product prices is an arbitrary matter to be decided by considerations of convenience. If, for example, there is a simultaneous change in the prices of two products,  $x$  and  $y$ , the consumer's surplus can be measured (a) in terms of a third good or in terms of a combination of several other goods at given prices, (b) in terms of  $x$  alone, (c) in terms of  $y$  alone, or (d) in terms of any combination of  $x$  and  $y$ . Again, using the numeraire suggested by any of the last three, the consumer's surplus can be measured either (i) as the maximum payment in terms of  $x$  and/or  $y$  (compensating variation for a price fall, equivalent variation for a price rise) required to restore the initial level of welfare, or (ii) as the minimum receipt of  $x$  and/or  $y$  (equivalent variation for a price fall, compensating variation for a price rise) necessary to achieve the new level of welfare without the change in price of  $x$  and/or  $y$ .

Alternatively, and more conveniently, the welfare change could be measured in terms of money income alone. In that case the worth of money is determined by reference to all goods, other than  $x$  and  $y$ , at their unchanged prices and by reference to  $x$  and  $y$  at their new prices if the compensating variation measure is used, or at their old prices if the equivalent variation is used. This holds irrespective of a rise or fall in the prices of  $x$  and  $y$ .

<sup>6</sup> The explicit profit-maximization assumption is not essential to this critique of producer's surplus. If all but several of a large number of firms in a perfectly competitive industry maximized money profits and these profits were zero in long-period equilibrium, these several firms would make less than zero profits and could not cover their full costs. On the other hand, one can imagine an industry in which there was a general agreement among managers to produce outputs that were smaller than the profit-maximizing outputs, deliberately sacrificing profit, or personal earnings, for greater leisure. All then may be better off than they would be maximizing profits. But the degree to which each is better off can be measured as a rent only by reference to his indifference map as between income and leisure, which information cannot be extracted from the firm's cost curve or the industry's supply curve.

(product prices constant) in exactly the same way that consumer's surplus provides a money measure of the welfare change arising from a movement in product prices (factor prices constant). Both economic rent so defined and consumer's surplus are derived by operating on the given preference map of the individual.

Having defined economic rent this way (which covers Marshall's "worker's surplus," just as consumer's surplus or producer's surplus can be made to cover his "saver's surplus"),<sup>7</sup> and having recognized it to be, like consumer's surplus, a measure of the gain or loss arising from a change in the terms of exchange facing a person, we must look elsewhere for an independent construct of producer's surplus.

### III

Since cost curves and supply curves derive from production functions, it seems apparent that producer's surplus is to be traced by operating on the isoquant, or production indifference map. The  $K$  and  $L$  axes of the isoquant in Figure 1 measure respectively real units of capital and labor. If we relate this isoquant to the firm, its long-period cost curve (with unchanged factor prices) can be derived from the output path along  $OR$  which, for homogeneous production functions, is a ray through the origin. In order for the familiar U-shaped envelope curve to be generated it is necessary that along  $OR$  we first pass through an area of increasing returns to scale until we reach the iso-product curve  $x_0$  after which we pass through an area of decreasing returns to scale. Once a plant size, say  $K_0$ , is chosen by the firm, its short-period average inclusive cost, with minimum point at  $R_0$ , can be derived from the output path  $K_0K'_0$ . The actual short-period expansion path, with labor the only variable factor, follows that part of its marginal cost curve emerging from the lowest point of the average variable cost curve. Since all firms in the competitive industry are assumed equally efficient, and since factor prices are held constant, the short-period supply curve for the industry is no more than the horizontal sum of the short-run expansion paths of the firms.

If, on the other hand, we take the isoquant in Figure 1 to be that facing the industry as a whole, the expansion path is no longer a ray  $OR$ . In the long-period equilibrium there is for the industry a relation between its output and factor prices. If  $x$  is a capital-intensive good and capital is less than perfectly elastic in supply, an equilibrium expansion of the output of  $x$  results in a rise in the price of capital relative to labor and, therefore, a shift toward using an increased proportion of labor. The

<sup>7</sup> If a man exchanges a stock of money for a security he can be thought of as buying a yielding asset in which case the welfare effects of a change in its price (with constant yield) can be measured as a consumer's surplus. Alternatively, he can be thought of as lending the services of his money for an annual fee in which case the welfare effects of a change in the rate of interest—payment for his factor services—can be measured as an economic rent.

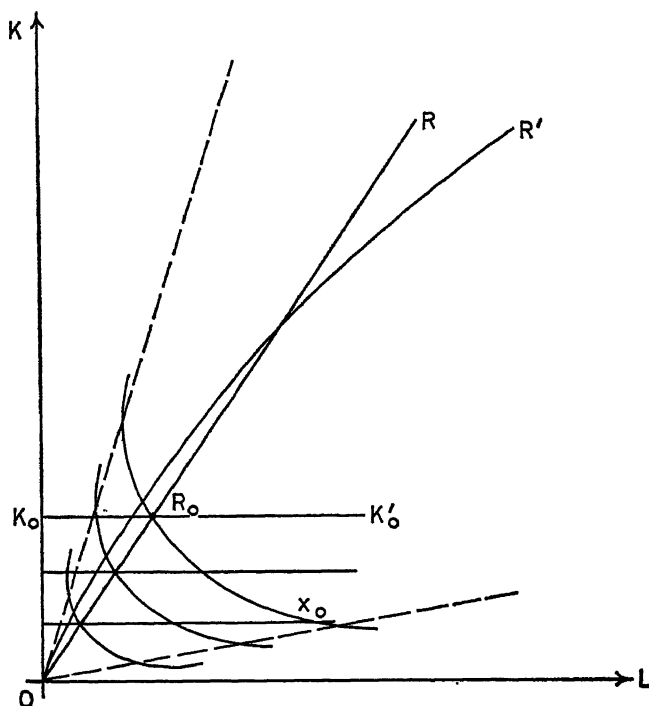


FIGURE 1

long-period expansion path of the industry would then be a line bending to the right as  $OR'$ . Conversely, if  $x$  is labor-intensive, such a line bends to the left.

This restatement of the familiar is necessary before examining the pertinence of the area above the supply curve as a measure of producer's surplus. Thus, the area above the industry's supply curve has a clear meaning only for the short period; for situations in which one factor, capital, is fixed in quantity and the other factor, labor, fixed in price, is varied over the range of diminishing average returns to labor. Two familiar instances are formally identical, (a) Marshall's short-period quasi-rent and (b) Ricardian rent to a fixed supply of land in the economy.

(a) Marshallian quasi-rent in the industry is the sum of the surpluses made by each firm, where each firm's surplus is the sum of the surpluses it makes on each product sold. The surplus on each product is the excess of the price over the marginal cost of labor incurred in its production. Since the firms' surpluses are positive, they make a positive contribution to the firms' overheads, or capital costs, which contribution is attributable, ultimately, to the owners of capital. Within the short period, dur-

ing which capital retains its specific form, the area above the supply curve as a measure of quasi-rent is clearly relevant: a decision to employ this capital equipment in one use rather than another is determined by a comparison of the resulting quasi-rents in the alternative uses.

(b) Ricardian rent, on the other hand, has reference to a long period over which labor and capital, both of them at fixed prices, (and therefore applied in fixed proportions<sup>8</sup>) can be varied without any alteration in the supply of land. Again, the surplus itself is identified as the sum of the surpluses on each unit of output, with each unit of surplus being defined as the excess of the price over the marginal cost of labor-and-capital incurred in its output. Over the long period the area above the supply curve<sup>9</sup> as a measure of rent is, again, clearly relevant: the decision to employ a certain piece of land, for example, in one use rather than another is determined by a comparison of the resulting rents.

Such instances as these, however, are properly regarded as examples of economic rent as previously defined [12], notwithstanding that they are apparently derived with reference to the production function and seemingly without reference to people's preference functions. The compensating variation definition of rent is the maximum sum a factor-owner would pay to have the full benefit of a rise in the price of his factor. The equivalent variation definition is the minimum sum he will accept to forgo the benefit of the price rise. If the income effect—or, more accurately, the welfare effect—is zero, either definition produces exactly the same measure. And if the factor-owner is concerned only with pecuniary advantage, this measure will be identical with the area above the supply curve reckoned as a sum of money. All of the Marshallian quasi-rent is to be imputed to the owners of specific capital equipment (at least in riskless situations). Ricardian rent is obviously to be imputed entirely to the owners of nonmarginal land.

#### IV

The area above the long-period supply curve of an industry appears to offer, for policy purposes, the more significant measure of producer's surplus. Certainly it would seem that the criterion suggested by Hicks in 1940 [5], that (assuming universal perfect competition) consumer's sur-

<sup>8</sup> With a homogeneous production function having negative second derivatives at all points along the iso-product curves, efficient production implies that factor proportions are uniquely determined by relative factor prices.

<sup>9</sup> It is, of course, a familiar proposition that in order to identify any quasi-rent, or rent, as the area above the supply curve, this curve must be conceived as a marginal curve exclusive of rent. Once the rent or quasi-rent is derived in this way, and is added at each point of output to the average cost of the *variable* factors, then the same supply curve can be taken to represent the average cost at each output including rent or quasi-rent to the fixed factors. In this connection see Ellis and Fellner [4, pp. 497-502].

plus producer's surplus positive<sup>10</sup> would justify the introduction of a new commodity, implies a long period supply curve. If, in a limiting case, we took consumer's surplus to be zero, the criterion that producer's surplus be positive could be compared with the familiar investment criterion that  $PV_i(A)$  be positive—where  $PV_i(A)$  represents the present value of the  $A$  stream of net returns discounted at  $i$ . The positive producer's surplus would then be measured as the area above the long-period supply curve, an average curve that includes all capital charges.<sup>11</sup>

We turn therefore to the long-period supply curve for a competitive industry  $x$ <sup>12</sup> in which, following standard textbook procedure, we assume all firms are of equal size and efficiency. With unchanged techniques, some inelasticity in the supply of each factor, and an absence of external economies, the minimum long-period average inclusive cost curve for each firm rises as supply is expanded in response to increasing demand. This rise in the industry's supply curve reflects the growing scarcity of the factor that is intensive to the product  $x$  in question. With only two factors, capital and labor, the production of an increased supply of  $x$  entails a rise in the price of capital relative to labor and, owing to the greater weight of capital in  $x$ , a rise in its per unit cost relative to labor-intensive goods. With unchanged demand for an unchanged stock of money this translates into a rise in the average money cost of  $x$ .

Irrespective of the change in factor proportions as we move along the long-period supply curve of the industry, the size of each firm in terms of output (as determined by the minimum average inclusive cost) is given by technology. Consequently any long-period expansion of the total supply of  $x$  entails a larger number of firms.

What is significant, however, is that (always allowing for sufficient divisibility) each point on the long period industry supply curve  $SS'$  in Figure 2 represents the lowest average inclusive cost for that particular output to the industry and also to each firm in the industry. Thus, at industry outputs  $x_1, x_2, x_3$ , the minimum long-period average cost for each firm is, respectively,  $x_1m_1, x_2m_2, x_3m_3$ , these being the lowest points on each of the typical envelope curves  $s_1s_1, s_2s_2, s_3s_3$ , that correspond to

<sup>10</sup> In this paper [5] Hicks equated a constant marginal utility of money with zero income effect. Needless to say, zero income effect is consistent also with increasing or diminishing marginal utility of money.

<sup>11</sup> Hicks calls his  $S S'$  curve in Figure 1 [5, p. 113] a marginal curve for the industry. Unless he is thinking of the Ricardian land case he must be following Marshall's assumptions: constant prices for all variable factors with the upward-sloping supply curve the result simply of ranking firms in order of efficiency. This construction is less general than the upward-sloping long period supply curve of the industry which results when firms of equal efficiency respond to an expanding market demand.

<sup>12</sup> I have restricted myself in this paper to a critique of producer's surplus as popularly used in partial equilibrium analysis where it is thought to be the obvious counterpart to the consumer's surplus concept. The erroneous construct of producer's surplus drawn from a general equilibrium analysis requires different arguments, and is dealt with briefly in the Appended Note.

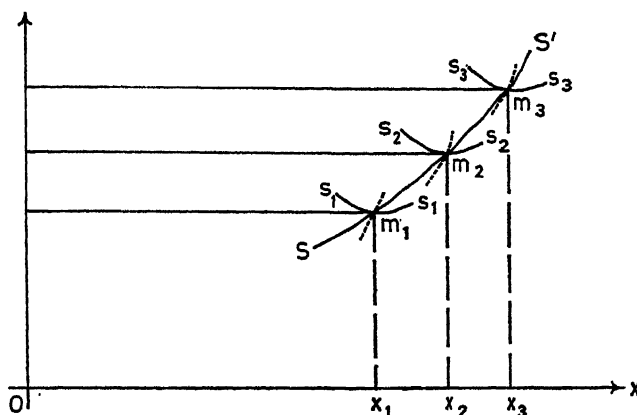


FIGURE 2

these industry outputs  $x_1, x_2, x_3$ . The firms' minimum average costs for each of these industry outputs is also equal to their long-period marginal costs.

It should be clear that as we move along the industry's long-period supply curve  $S S'$  the rent of one factor will, in general, rise relative to the rent of the other factor—which, unless there are increasing returns to scale, will decline in real terms. And while it is manifest that the inelasticity of substitution, and therefore, the extent of the change in relative rents, is connected with the steepness of the industry supply curve, neither the slope of that curve nor the area above it can be associated with a net gain by both factors taken together, or a net gain by producers each of which in the long period makes zero profit.

For the purpose in hand, the industry supply curve  $S S'$  must be regarded as an average curve: at any equilibrium output, say  $Ox_1, x_2, x_3$ ,  $m_1, m_2, m_3$  is the average cost to each firm and to the industry. True,  $x_2, m_2$  is also the marginal cost to each firm, but it is *not* the marginal cost to the industry. Put otherwise, the industry supply curve is, admittedly, an average cost curve *including* rents—the rents of both factors in fact, since these alter as the industry's equilibrium output expands. But it is *not* also a marginal curve *excluding* rent (as is the Ricardian average cost curve). An average curve including rent, equal to a marginal curve excluding rent, can be derived only in those cases in which rent accrues to a single fixed factor, all other factors being infinitely elastic. In the more general case, however, where the changes in rents of all factors are fully taken account of in the average curve, including of course the rental of capital (but no Knightian profit), the area above the rising industry supply curve carries no economic significance.<sup>13</sup>

<sup>13</sup> Although the measurement of producer's surplus is generally linked to the upward-sloping supply curve of a competitive industry, it may be observed in passing that the cost curve of

## V

To conclude, the area above the supply curve referred to as "producer's surplus" may be used along with consumer's surplus only for a particular type of supply used in partial equilibrium analysis; namely, that constructed for a period during which the output of the good in question can be increased only by adding to fixed-factors amounts of other factors that are imperfect substitutes for it but are perfectly elastic in supply with respect to their money prices. In such cases the rent of the fixed factor is exactly equal to the area above the supply curve under the conditions mentioned—zero welfare effect and complete indifference to nonpecuniary advantages. The further we move from these conditions, especially the latter condition, the greater the divergence between the true rent (either compensating or equivalent variation) and the area in question. Provided price everywhere else is equal to social marginal cost the familiar qualitative tax-subsidy propositions, based on the geometry of consumer's and "producer's surplus," hold true even though the areas involved are generally only an approximation to the combined losses or gains.

In contrast, we cannot derive a "producer's surplus" from a supply curve along which all factors are variable. Thus we cannot derive a "producer's surplus" from an industry's long-period supply curve. Such a curve is not marginal to an average curve that is made up of the cost of the other (variable) factors at fixed prices. In this more general case in which all factors are variable in supply, the industry's supply curve necessarily includes all factor prices and, therefore, all rents. Thus, the price of each factor, and the proportions in which each is combined with the others, must be known before the unit inclusive cost—equal to price in long-period competitive equilibrium—can be determined. Put differently, at each point on the long-period industry supply curve "Euler's theorem" is met: the product is exhausted by paying to each of the contributing factors its full marginal product. Nothing is left as a surplus to any agent of production, and Knightian profit is zero.

In cases such as these the notion of "producer's surplus" is inapplicable, and all welfare propositions deriving from areas above such long-period supply curves are invalid.

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a monopolist does not measure a producer's surplus either. Monopoly profit, or "monopoly rent," arises strictly speaking from the "exploitation" of the consumer's-demand curve. It is measured not by the area above the long-period cost curve (which curve may be horizontal), but by the area between the long-period cost curve and the price, *imes* output: alternatively, by the net positive area enclosed between the marginal cost and marginal revenue curves. If the latter measure is used, one cannot associate a producer's surplus with the net positive area above the marginal cost curve alone, for the area below the marginal revenue curve is also a part of the monopoly profit (and not, as required in the usual welfare treatment associated with this sort of geometry, a measure of consumer's surplus).

Finally, the term "producer's surplus" has been placed in quotation marks in this final section as a reminder that the term is misleading and otiose. It is misleading inasmuch as the term producer is misleading: it may refer to the owners of the agents of production or it may refer to the entrepreneur. Consequently, it may suggest rents, or it may suggest profits of some sort. It is otiose inasmuch as, in those special cases where the area above the supply curve may be taken as an accurate or approximate measure of the surplus, the money sum it represents is properly defined as economic rent to one of the factors of production, the concept of rent being therefore on all fours with the concept of consumer's surplus.

An additional advantage of excluding all reference to "producer's surplus" and restricting our terminology to economic rent is that it obliges us to identify the particular factor that is, over some period of time, inelastic in supply and therefore also the factor-owners to whom the rents are to be imputed. We are then not likely to be deluded into measuring nonexistent surpluses. For these reasons I recommend that the term "producer's surplus" be struck from the economist's vocabulary.

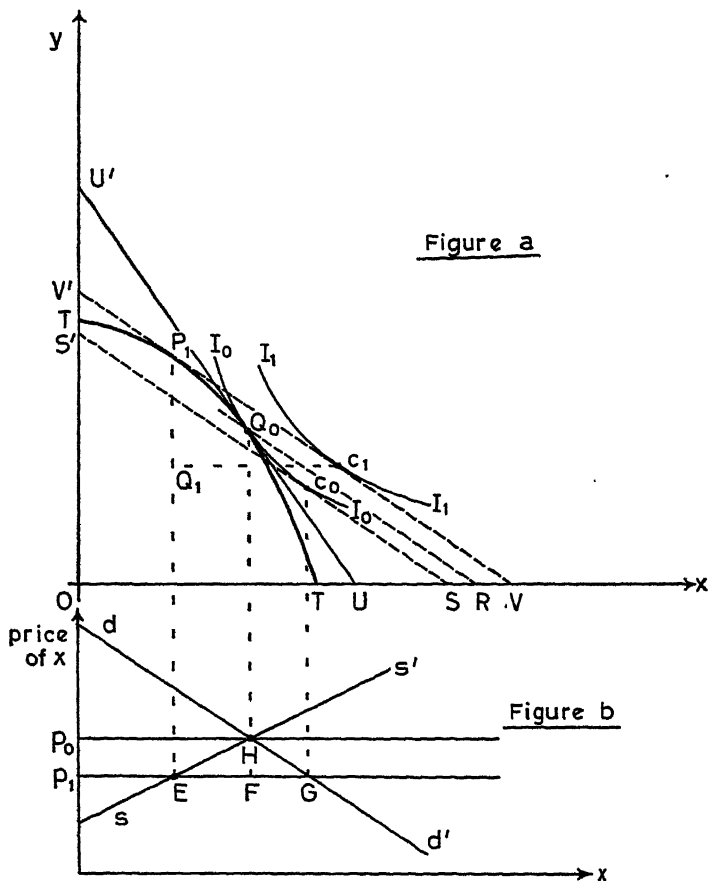
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## APPENDED NOTE

In this Note we shall briefly examine the attempt to derive a producer's (and consumer's) surplus from a "real" supply curve for a two-good economy—the marginal cost of one of the goods being expressed in terms of the other. From the convex transformation curve  $T T'$  and from the community indifference curve  $I_0 I_0$ , in Figure a, we construct respectively a



curve of marginal opportunity cost  $s s'$  and a compensated demand curve  $d d'$  in Figure b, both for units of  $x$  in terms of  $y$ .

The exposition will be more revealing if we adapt the Johnson analysis of the gains from removing a tariff [10, pp. 329–32] to the more extreme case of the gains arising from the complete removal of a previously prohibitive tariff. Once the tariff is completely abolished we move from  $Q_0$ , the autarkic collection of goods produced and consumed, to the completely free trade situation at the world terms of trade  $V V'$  at which  $C_1$  indicates the batch consumed,  $P_1$  the batch produced, with  $Q_1 P_1$  of  $y$  therefore being

exchanged for  $Q_1C_1$  of  $x$ . Adapting Johnson's argument to this special case,  $SR$  is to be identified with the *consumption cost* of the tariff and  $RV$  with the *production cost* of the tariff, both in terms of  $x$  at the world terms of trade. Their sum,  $SV$ , is the total gain from free trade.

In Figure b the substitution of the autarkic terms of trade  $U U'$  in Figure a for the world terms of trade  $V V'$  is translated into a reduction from the domestic price of  $x$  (in terms of  $y$ ),  $P_0$ , to the international price of  $x$ ,  $p_1$ . The distances  $SR$ ,  $RV$ , and their total  $SV$ , along the  $x$ -axis of Figure a, can be represented in Figure b as triangles  $FHG$ ,  $FHE$ , and  $EHF$ , respectively. What cannot be done, however, is to identify the gain in consumer's surplus as  $p_1p_0HG$ ,<sup>1</sup> the loss of producers' surplus as  $p_1p_0HE$ , with triangle  $EHG$  measuring the net gain of consumer's surplus over the loss of producer's surplus. For if we constructed a Figure b' (not shown here), with  $y$  measured along the horizontal axis and the price of  $y$  in terms of  $x$  on the vertical axis, exactly the same net gain would have to be interpreted instead as an excess of the gain of producer's surplus over the loss of consumer's surplus.<sup>2</sup> In the limiting case, if the country, either in trade or autarky, produces nothing but  $x$  the resulting producer's surplus in Figure b would appear as a maximum, whereas if it were depicted in Figure b' (not shown) the producer's surplus would appear as zero. The division of the welfare gain from free trade into gains (or losses) of consumer's surpluses offset by losses (or gains) of producer's surpluses is, therefore, quite arbitrary. Indeed, if producer's surplus is defined as to be coterminous with pure profit<sup>3</sup> then it is in any case zero for all (long-period) equilibrium positions, whether in autarky or free trade, for a perfectly competitive economy.<sup>4</sup>

It appears then that the attempt to separate a consumer's surplus from a producer's surplus in the construction of Figure a, or from its derived construction Figure b, is arbitrary and erroneous. It must be recognized that we have constructed two Pareto-comparable community indifference curves,

<sup>1</sup> In deriving Figure b from Figure a, the reader will observe that the point  $G$  in Figure b is taken to be directly below  $C_0$ . With as much justification  $G$  could be placed directly below  $C_1$ . Only if  $x$  has a zero "income" effect (or, rather, welfare effect) could  $C_0$  and  $C_1$  be on the same vertical line and, therefore, the compensated demand curve uniquely determined. If it were uniquely determined, however, we could not also construct a unique compensated demand curve for  $y$  in terms of  $x$ .

<sup>2</sup> It should be obvious that we would be counting the net gain from trade twice if we treated the net surpluses on both goods,  $x$  and  $y$ , as separate and addable—adding, that is, the excess consumer's surplus on  $x$  to the excess producer's surplus on  $y$ .

<sup>3</sup> If, on the other hand, producer's surplus is to be defined as factor rents, it should be manifest that they cannot be determined from the data in Figure a; only from a knowledge of people's preferences as between income and leisure. In general all we can say is that all factor prices change when we move from autarky to free trade. If, for example,  $x$  is labor-intensive, and the supply of labor is not perfectly elastic, the movement to free trade raises its price relative to that of capital. This entails a rise of rent to labor relative to rental of capital, but no overall net rise in rents.

<sup>4</sup> If, on the other hand, the economy is imperfectly competitive, we cannot say whether a shift of production from  $y$  to  $x$  increases or reduces profits without knowing the mark-ups on the two goods, information not yielded by Figure a.

$I_0I_0$  and  $I_1I_1$  in Figure a, passing through the consumption batches in the autarkic and free trade situations respectively. And the welfare gain is no more than the difference between them measured here as a single compensating variation at the new international price ratio—as  $SV$  along the  $x$ -axis or as  $S'V'$  along the  $y$ -axis.<sup>5</sup> Either can be interpreted as an exact measure of the gains for the community as a whole, or for a single person, in moving from the *consumption* possibilities presented by  $T T'$  to the new *consumption* possibilities presented by  $V V'$ .

<sup>5</sup> Alternatively, the welfare gains could be measured, again either in  $x$  or  $y$ , at the terms of trade  $U U'$  in the autarkic position. Needless to remark, though one will always show a gain by using the world terms of trade as an index, it is *possible* simultaneously to show a welfare loss in moving to the free trade situation using the autarkic terms of trade as an index.

## DETERMINANTS OF DIFFERENCES IN THE QUIT RATE AMONG INDUSTRIES

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Our point of departure in framing a theory of the rate of quits of employees from industrial establishments is a blend of the labor turnover corollary of the classical compensatory wage model of the competitive labor market and the discussion of labor turnover by March and Simon [2, Ch. 4]. The former implicitly predicts that as equilibrium is approached the quit rate would tend toward zero. For March and Simon, equilibrium occurs when the sum of the individual worker's "inducement utilities" equals his "contribution utilities." "Increases in the *balance of inducement utilities* [i.e., remuneration, comprehensively defined] *over contribution utilities* [i.e., work expended] decrease the *propensity of the individual participant to leave* the organization, whereas decreases in that balance have an opposite effect" [2, p. 93].

The balance is a function of two components: (i) the perceived desirability or undesirability of leaving the employer, and (ii) the perceived ease or difficulty of movement from the employer. Simon and March's discussion of the factors affecting labor turnover is in terms of the influences affecting these two components [2, pp. 93-106]. The discussion is exhaustive and we do not repeat it here.

With respect to the framework afforded by the classical model, we assume that all workers seek to obtain the highest possible cash income given their individual preferences for money and leisure and the earnings opportunities available to them. Hence this assumption does imply that workers will quit low-wage jobs in pursuit of high-wage jobs, and that they will prefer quiet working conditions to noisy conditions, and so forth, but that they may vary among themselves with respect to their individual terms of trade among all conditions describing the work situation.

In order to subject this formulation to actual experience we delete those variables for which data are unavailable and then advance a set of nine variables which give theoretical promise of explaining differences in the quit rate among industries. Alas, industries—not companies, not establishments. Compromise imposed by the limitations of the data thus asserts itself at the outset. Ideally, the effort calls for establishment data.

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But labor turnover information is available at the industry level only. Moreover, the group of 52 industries studied, selected exclusively on the basis of the availability of the data,<sup>1</sup> range from the homogeneous four-digit SIC level at one extreme to the heterogeneous two-digit level at the other.

Fortunately, satisfactory results are obtained when a test is made of the implicit assumption inhering in the use of industries as proxies for establishments—specifically, the variance of the featured variables is greater among industries than within industries. For the quit rate itself, the dependent variable, the standard deviation of the complete sample of industries exceeds by more than 50 per cent the mean of the standard deviations of the industries within the sample consisting of three or more subindustries. For the layoff rate, the former exceeds the latter by 380 per cent. And for the last variable thus tested, the proportion of industry employment in large establishments, those with 250 or more workers, the comparable percentage is 20.<sup>2</sup> While these results are adequate enough to proceed with the study, clearly they signal the likelihood that some of the error in what follows is introduced by the less than complete realization of the homogeneity assumption.

A second limitation arises from the insufficiency of data descriptive of variables which we would have included had the necessary information been available by industry. These pertain to location in relation to the cost of living, to the incidence of night-shift work, and to the age structure.

### *I. The Explanatory Variables—Two Classes*

Reserving to the Appendix most of the description of the details of measurement and of sources, in the following pages we identify each of the explanatory variables and their associated hypotheses. Consistent with the March-Simon two-component formulation, the variables are grouped into two parts. The first includes those which relate to the worker's perception of the desirability of quitting or remaining with his employer. The second group pertains to the worker's perception of the ease or difficulty of changing employers.

### *II. The Desirability of Quitting or Staying*

#### *Wages, $X_1$*

March and Simon predict that the magnitude of rewards is inversely related to the propensity to quit [2, pp. 95–96]. We express rewards for each industry in terms of gross average annual earnings of all employees.

<sup>1</sup> For details see the Appendix, which is available upon request to R. L. Raimon, School of Industrial and Labor Relations, Cornell University, Ithaca, N. Y. 14850.

<sup>2</sup> For detailed information on this test, see the Appendix.

Since the structure of the interindustry wage level is predominantly a function of differences in the skill-mix among the individual industries,<sup>3</sup> the earnings are standardized to the same skill-mix by being divided by an index of the quality of the work force.<sup>4</sup> To illustrate, average actual annual earnings in the motor vehicle industry in 1963 were \$7,485. Had the workers in the occupational profile of this industry been paid at a rate of earnings equal to our estimates of the U.S. occupational averages, with appropriate allowance for varying hours input among occupations, they would have earned 108.6 per cent of the average pay for all industries. Actual earnings, \$7,485, divided by 108.6 are \$6,892. It is this latter value that we record as  $X_1$  and which we compute for the other 51 industries studied. Ideally, this rewards variable should include a comprehensive money value of fringe benefits, but no such data are available at the appropriate level of industry definitions. Included in the measure used are vacation and sick leave pay, dismissal pay, and bonuses, but excluded are employer contributions to social security, to pension plans, group insurance premiums, and workmen's compensation.

### *Recent Wage Increases, $X_2$*

The magnitude of recent wage changes is the second independent variable. Separable from the level of wages but companion to it is the proposition that in an economy where the fruits of rising productivity are disbursed chiefly in the form of increasing money wages, all employers, unionized or not, are under pressure to keep pace with changes in area or industry wage levels [5, p. 159]. Failure to do so invites withholding efficiency, and of immediate relevance, higher quit rates.

We use the wage change over the three years ending in 1963 or in 1966 on the grounds that three years is brief enough to be regarded as recent but long enough to accommodate the results of long-term collective agreements that might have been in effect in manufacturing industries in the periods studied. The wage measure is gross weekly earnings of production workers. Accepting Becker's argument to the effect that the absolute magnitude of wage change is the appropriate measure to apply to labor supply considerations [1, pp. 52-55], as in the instant case, we would have liked to have been able to use this measure. Unfortunately, the absolute rise is correlated with the level of annual earnings ( $r = .601$  for 1963). In consequence, we report subsequently on the percentage increase only, which does not vary systematically with the level of earnings ( $r = -0.33$  for 1963).

<sup>3</sup> See [4, p. 282] wherein a .6 rank correlation by industry between richness of the skill-mix and level of earnings is reported.

<sup>4</sup> The index of the quality of the work force is a slightly modified version of an index proposed by the present authors in [3, pp. 391-413]. For further details, see the Appendix.

*Size of Establishment, Quality of Personnel Management, and Concentration,  $X_3$*

Industrial sociology suggests that size of the work unit is related inconsistently to the propensity to quit [2, pp. 98–99]. When size refers to the magnitude of the “work group” or to the number of workers in the “job cluster,” the generalization is to the effect that the smaller the size of the unit, the less conflict is there between the role of the individual worker in the discharge of his job duties, in what the behaviorists refer to as the “organizational role,” and the worker’s other roles in life. The same size-compatibility proposition obtains with respect to the size of company [2, pp. 98–99]. Hence, thus far we have size inversely related to quits. On the other hand, company size confers status or prestige, and this would serve to prompt an inverse relationship between size and quits.

More conjectural but still relevant is the proposition that nepotism is as inversely related to size of employer as it is positively related to the propensity to quit. Also, as between medium-sized establishments and large establishments, it is not necessarily true that the number of workers in job clusters is any greater in the former than in the latter.

Equally uncertain is the relationship between the quality of personnel management and size—the former constituting a presumptively important variable for which adequate independent data are lacking but which may be partially reflected in the size factor. On the one hand, it is reported that size of company is inversely related both to median per worker expenditures on employee relations activities as well as to the median ratio of personnel staff members per 100 employees [9, pp. 22–23]. Of course, inferences from such findings are frustrated by the absence of a companion measurement of the economies of scale involved. On the other hand, the salaries of job analysts satisfying BLS job descriptions at grades II, III, and IV and of directors of personnel meeting the same criterion at grades III and IV are found to be uniformly higher, on the average, among establishments employing 2,500 or more workers than in the average of all establishments [11, Tables 1, 3]. This suggests that the quality of personnel staff employees in large establishments is superior to the quality in other establishments.

Finally, unambiguous is the fact that the BLS does not count inter-establishment transfers within companies as quits. Hence, on this score, especially to the extent that size of establishment is a good proxy for size of company, we would expect establishment size to be inversely correlated with the quit rate.<sup>5</sup> “The larger the organization, the greater the *perceived possibility of intraorganizational transfer* and therefore, the less

<sup>5</sup> Quit rates are reported on an establishment basis.

the perceived desirability of leaving the organization" [2, p. 99]. That establishment size and company size are highly correlated is evidenced by a rank correlation coefficient of .996 in a representative set of 78 four-digit industries.<sup>6</sup>

In summary, we hypothesize that the sum of the influences exerted on the quit rate by size in relation to role conflicts, prestige or status, nepotism, job cluster populations, the quality of personnel management, and intracompany promotion or transfer possibilities is of uncertain sign.

Concentration ratios in relation to the quit rate were considered for inclusion in the regressions which follow, but rejected. As in each instance, the intent conceptually is to hold the given variable in isolation against the dependent variable. Thus, concentration was rejected because no theoretical reason could be found for including it once account had already been taken of the high correlation between concentration and size ( $r = .677$ ) and the high correlation between concentration and earnings ( $r = .583$ ).<sup>7</sup>

#### *Union Occupancy Rate, $X_4$*

Independent of the relative wage level and fringe benefit package, the more effective the system of industrial jurisprudence, the higher will be job satisfaction and hence the lower the quit rate. This proposition focuses on the integrity of the grievance machinery, implying, of course, the presence of *bona fide* trade union representation. Only through the operation of the grievance machinery may the worker effectively pursue redress of unjust treatment.

The closest we can come to quantifying this variable is the union occupancy rate. Clearly, this is a highly imperfect measure, implying as it does a homogeneity assumption about the quality of unions in general and the properties of their grievance machinery in particular. Indeed, the occupancy rates themselves are based upon data that leave much to be desired. Nevertheless, they are the best available.

#### *Layoff Rate, $X_5$*

The greater the threat of being involuntarily separated from an employer, the greater the likelihood of voluntary separation—the higher the layoff rate in a given industry relative to other industries, the higher the quit rate. March and Simon discuss the level of general business activity, to which we turn in the next section, but they make no mention of the particular level of economic performance of the organization or industry in which the employee is working. The latter affects the desir-

<sup>6</sup> For details, see the Appendix.

<sup>7</sup> The concentration values are from [8, Appendix].



ability of movement, while the former establishes the opportunity or ease of movement. These should not be confused.

A high layoff rate by definition threatens the employee's security. Specifically, it diminishes the margin of protection against loss of employment for those still employed and therefore capable of quitting; this follows from the diminution in the buffer zone occupied by junior employees, in conformance with the usual pattern of last-in, first-out bumping and layoff procedures characteristic of the rule of seniority systems in unionized manufacturing establishments, and to a lesser but still important degree in nonunion firms. Thus to measure this effect we use the layoff rate by industry.

This completes our list of variables pertaining to the desirability of quitting. Next we review those variables associated with the perceived ease of worker-initiated movement.

### III. *The Relative Ease or Difficulty of Changing Employers*

#### *General Business Activity*

"The lower the *level of business activity*, the less the number of extra-organizational alternatives" [2, p. 100] [7, pp. 903-20]. Our test consists of a comparison of a cross-sectional analysis at two different points in time, 1963 and 1966, with contrasting levels of business activity. This does not provide sufficient information to determine the size of the effect of the level of business activity upon the quit rate. Nevertheless, the direction of the effect will be clear from a comparison of the two cross-sections.

#### *Per Cent Negro, $X_6$*

The sociologists' and the labor market analyst's proposition is to the effect that the perceived availability of outside alternative job opportunities is inversely related to the social status of the worker [2, p. 102]. Reinforcing this generalization is the observation that minority group members tend to cluster, in part perhaps to reduce their visibility and hence their vulnerability to discrimination. Thus we hypothesize that the proportion of Negro workers in an industry will be inversely related to the industry's rate of quits. Male Negro employment as a proportion of total male employment is the measure used. The analysis is restricted to males in order to avoid overlapping with  $X_7$ , the proportion of female employment.

#### *Per Cent Female, $X_7$*

"The perceived availability of outside alternatives is a function of the *sex of the participant*. Male workers will perceive movement to be easier than will female workers" [2, p. 101]. To the extent that females suffer

discrimination in the market for labor, this hypothesis commands agreement, *ceteris paribus*, in an argument similar to that offered in the paragraph above pertaining to Negroes. But other things are not equal between the sexes. Men who quit an employer do so to take up another job or at least to look for another job. Women have these reasons and more, including marriage, pregnancy, child care, and so forth. This will have the opposite effect on the quit rate from the one posited in the quotation above. Also, female employment is much more concentrated among a relatively small number of occupations than is male employment, particularly among office clerical jobs. In consequence, women more than men can change employers and industries while retaining their occupational identity. As a result, one would expect female quit rates to exceed male rates.

In sum, the net effect of sex, measured by the per cent of females in total industry employment, is in doubt and we do not predict the sign of the regression coefficient.

#### *Per Cent With Brief Job Tenure, $X_8$*

"The longer the *length of service* of the employee, the greater his *specialization*; the greater his specialization, the fewer the extraorganizational alternatives perceived" [2, p. 102]. We have chosen to disaggregate this proposition into two simple hypotheses. The first one posits that the shorter the length of service, the higher the quit rate. The second one is to the effect that the greater the specialization, by which we mean level of skill, the lower the quit rate.

Underlying this bifurcation of the quoted proposition is the notion that a high level of skill and of specialization can be acquired without long tenure in one organization or even in one industry—chiefly through pre-employment training. Furthermore, the predominant reason that the propensity to quit is highest among short-service personnel is not degree of specialization but rather what Reynolds terms, "The intrinsic difficulty of 'window shopping for jobs,' the fact that many of the most important features of a job cannot be appraised until one has worked on it" [5, p. 109].

Length of service is measured in two ways: (i) by the percentage of total employment in an industry with brief job tenure (six months or less), and (ii) the new hire rate. The latter is used because a high rate of new hires is an indicator of the proportion of the work force with brief service.

#### *Quality of Work Force, $X_9$*

As a measure of employee specialization we use the index of quality of employment, mentioned earlier under  $X_1$ . Thus besides being used to

adjust annual earnings by industry, the index is used as an additional independent variable to measure specialization, i.e., richness of the skill-mix.

This completes the list of independent variables.<sup>8</sup> Table 1 summarizes the foregoing remarks and repeats the notations for each of the variables as they are reported in the multiple regression analysis that follows.

TABLE 1—VARIABLES USED IN REGRESSION ANALYSES

Description of Variable	Symbol Used in Analysis	Expected Effect of an Increase of Variable on Quit Rate
Quit rate by industry	$Y$	
1. Average annual earnings adjusted for the quality of work force	$X_1$	negative
2. Percentage increase in earnings over last three years (production workers)	$X_2$	negative
3. Per cent of employment in establishments with more than 250 employees	$X_3$	not clear
4. Union occupancy rate	$X_4$	negative
5. Layoff rate	$X_5$	positive
General Business activity	—	positive
6. Per cent male Negro	$X_6$	negative
7. Per cent female	$X_7$	not clear
8. Per cent with brief job tenure	$X_8$	positive
New hire rate	$X_{8a}$	positive
9. Quality of work force	$X_9$	negative

#### IV. *The Statistical Test of the Hypothesis*

Using the hypothesis developed above as a base, we have formulated a linear regression model for the 52 industries in our sample<sup>9</sup> in an attempt to test the general hypothesis that the quit rate is determined by the factors or variables as specified in Table 1. The original sample was collected for the year 1963, the latest year for which values for all the variables were available.<sup>10</sup> Unfortunately, 1963 was not a full-employment year, and therefore not a particularly good year to test the hypothesis. In periods of relatively high unemployment people may decide to move, but are very likely to postpone such a move until opportunities for finding a new position improve. Hence we test the hypothesis for the year 1966, using all the available information for 1966, and supplementing it with the 1963 values or the values of other years for the inde-

\* An earlier version of this paper contained the additional variable "per cent operatives in work force" as a proxy for the extent of specific training. The theoretical justification for our choice of a proxy was weak, and the variable is omitted from the present effort. Furthermore, the variable turned out to be statistically not significant.

<sup>9</sup> See the Appendix for a discussion of a choice of sample.

<sup>10</sup> Except that  $X_9$  is based in part on 1960 data, as explained in the Appendix.

pendent variables for which 1966 values could not be obtained. Four such patch-work variables were used ( $X_1$ ,  $X_3$ ,  $X_6$ , and  $X_9$ ). This gives us an opportunity to compare the 1963 with the 1966 results and to observe the effect of improved general business conditions on the decision to move from an industry.

It is significant to the reliability of the overall results, to be presented in a moment, that there is an overwhelming lack of intercorrelation in the independent variables: see Table 2. However, from the outset of the statistical analysis we had to face a problem of aggregation in connection with variable  $X_8$  (per cent of the labor force with six months or less tenure), the variable used to measure length of service. The difficulty with this variable, which on conceptual grounds is quite satisfactory, is the fact that it is available only for industries on the two-digit level classification, while the majority of our observations belong either to single three-digit industries or to partial combinations of such. This required assigning an  $X_8$  value to three-digit industries by reference to their slot in the two-digit industry of which they are a part.<sup>11</sup> A partial attempt to solve this problem is made substituting for  $X_8$  the new hire rate,  $X_{8a}$ , as a measure of length of service. This is far from a perfect solution, and we shall discuss it later.

### *Main Findings*

We summarize the main findings in the following way (See upper part of Table 3):

1. All reasonably significant coefficients (for  $t > 1.30$ ) have the sign posited in Table 1.
2. The extent of the variance of the quit rate "explained" by independent variables ranges from 72.8 per cent for 1963 to 73.6 per cent for 1966.
3. Our hypothesis was not explicit on the sign of the regression coefficient for size of establishments,  $X_3$ , because of countervailing forces. In fact it turns out to be reasonably significant only for 1963 with a negative sign ( $t = -1.77$ ).
4. Our hypothesis was not explicit on the sign of the regression coefficient for the percentage of females in the work force,  $X_7$ . There is no support for the significance of this variable.
5. Considerable change in the regression coefficients occurs between 1963 and 1966, as was expected. This change is summarized in the following section.

### *Comparison with Improved Economic Conditions*

The difference between the 1963 and 1966 runs can be attributed to

<sup>11</sup> For a more detailed explanation, see the Appendix.

TABLE 2—COEFFICIENTS OF SIMPLE CORRELATION AMONG ALL THE VARIABLES

	1963									
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>	X <sub>9</sub>	Y
X <sub>1</sub>	1.000	.217	.534	.496	-.217	-.243	-.349	-.516	.553	-.714
X <sub>2</sub>	-.033	1.000	.129	.102	.241	.292	-.232	-.012	.155	-.129
X <sub>3</sub>	.534	.101	1.000	.277	-.129	-.188	.157	-.359	.188	-.484
X <sub>4</sub>	.489	-.125	.242	1.000	-.007	-.099	-.434	-.377	.430	-.562
X <sub>5</sub>	-.148	-.284	-.118	-.054	1.000	.351	-.029	.187	-.211	.367
X <sub>6</sub>	-.243	-.197	-.188	-.080	.386	1.000	-.214	.409	-.174	.183
X <sub>7</sub>	-.360	-.079	.153	-.441	-.019	-.223	1.000	.126	-.602	.378
X <sub>8</sub>	-.389	.061	-.286	-.393	.019	.080	.098	1.000	-.232	.592
X <sub>9</sub>	.553	-.096	.188	.450	-.270	-.174	-.589	-.026	1.000	-.550
Y	-.726	-.175	-.531	-.528	.368	.303	.282	.378	-.592	1.000

X<sub>1</sub>=Adjusted average annual earningsX<sub>2</sub>=Percentage increase in earningsX<sub>3</sub>=Per cent employment in large establishmentsX<sub>4</sub>=Union occupancy rateX<sub>5</sub>=Layoff rateX<sub>6</sub>=Per cent NegroX<sub>7</sub>=Per cent femaleX<sub>8</sub>=Per cent with brief tenureX<sub>9</sub>=Quality of work force

the changed economic climate over that period. Table 4 brings together some of the more important changes in the economy and in the sample. The unemployment rate of experienced wage and salary workers was reduced from 5.5 per cent to 3.5 per cent. At the same time, the quit rate in manufacturing increased from an average monthly rate of 1.4 to 2.6, or almost doubled.

As posited, all the regression coefficients of the variables that were reasonably significant either in 1963 or in 1966 (or both) increased in size and retained their signs with the exception of the coefficient of  $X_1$ , per cent male Negro in the work force, whose significance in 1963 is of some doubt ( $t = -1.36$ ). This involved at the same time a shift in the regression coefficients that were significant. The general conclusion is that the coefficients of the variables that pass usually as "economic" increased in statistical significance with improved business activity (level of rewards,  $X_1$ ; recent change in rewards,  $X_2$ ; and the quality of the work force,  $X_3$ ). Meanwhile the coefficients of the more "institutional" variables decreased in statistical significance (size of establishment,  $X_4$ ; union occupancy rate,  $X_5$ ; per cent Negro,  $X_6$ ; and per cent of work force with six months or less of tenure,  $X_7$ ). The level of significance of the layoff rate,  $X_8$ , decreased considerably as an exception to the general conclusion, but note that here too the size of the regression coefficient increased.

### *The New Hire Rate as an Alternative Measure of Length of Service*

As mentioned earlier, because of certain data difficulties, a substitute measure was tried for the length-of-service variable used in the results reported so far, even though there was no shortage of theoretical grounds for not introducing the new expression of the variable. The new hire rate seems a plausible measure of proportion of the work force of an industry with a short tenure in that industry. Unfortunately, there are both theoretical and empirical grounds for doubting the appropriateness of its use in the present study.

To begin with, the new hire rate is highly correlated with two other independent variables: with average annual earnings corrected for skill,  $X_1$  ( $-.638$  for 1963 and  $-.658$  for 1966), and with the layoff rate,  $X_8$  ( $.665$  for 1963). This by itself puts considerable doubt on the results presented in the lower part of Table 3, where the new hire rate is used as a substitute for the per cent with brief job tenure.

The theoretical argument that can be made against the use of the new hire rate is that very likely it is a good measure of things additional to that which we seek to measure. The new hire rate, for example, is a measure of labor market conditions perhaps to a greater extent than it is of length of service. It thus might measure opportunities in other indus-

TABLE 3—REGRESSION COEFFICIENTS  
(*t* values in parentheses)<sup>a</sup>

Regression Variant	Variable Included										R (d.f. in paren- thesis)
	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>4</sub>	X <sub>5</sub>	X <sub>6</sub>	X <sub>7</sub>	X <sub>8</sub>	X <sub>9</sub>	X <sub>10</sub>	
1963 β coefficients <sup>b</sup> Effect of 1 per- centage change of variable <sup>b</sup>	-.00192 (-1.66)	-.0224 (-.10)	-.0542 (-1.77)	-.0690 (-2.03)	1.37 (2.88)	-.238 (-1.36)	.0359 (.70)	.496 (2.84)	-.105 (-1.22)	.853 (42)	
	-.219		-.193	-.206	.261	-.144		.295			
	-.668		-.204	-.295	.146	-.103		.349			
1966 β coefficients <sup>b</sup> Effect of 1 per- centage change of variable <sup>b</sup>	-.00592 (-2.82)	-.867 (-2.35)	-.0623 (-1.05)	-.129 (-1.89)	1.79 (1.40)	-.105 (-.34)	-.126 (-1.23)	.496 (1.55)	-.485 (-2.76)	.858 (.42)	
	-.362	-.227		-.198	.132			.148	-.371		
	-1.075	-.358		-.285	.065			.232	-1.703		
1963	-.00122 (-1.32)	-.028 (-.15)	-.0013 (-.05)	-.018 (-.63)	-1.25 (-2.18)	-.132 (-1.01)	.011 (.27)	.547 (6.14)	-.092 (-1.36)	.910 (42)	
	-.00219 (-2.29)	-.354 (-2.15)	-.0068 (-.26)	-.035 (-1.15)	-.713 (-1.20)	.369 (2.63)	-.027 (-.59)	.755 (13.67)	-.093 (-1.21)	.974 (42)	

<sup>a</sup> Critical values for *t* are approximately ±2.69 for 99 per cent, ±2.02 for 95 per cent, ±1.68 for 90 per cent, ±1.30 for 80 per cent.<sup>b</sup> Only coefficients with a *t* > 1.30 recorded.

TABLE 4—IMPORTANT CHANGES BETWEEN 1963 AND 1966

	1963 (Per cent)	1966 (Per cent)
Total civilian unemployment rate	5.7	3.8
Experienced wage and salary workers' unemployment rate	5.5	3.5
Quit rates in manufacturing (average monthly rate)	1.4	2.6
Significant changes in means (unweighted) and standard deviation (s.d.) in sample of 52 industries:		
Quit rate (addition of 12 monthly rates)	15.66 (1.3) <sup>a</sup>	29.92 (2.5) <sup>a</sup>
s.d.	6.31 ( .5) <sup>a</sup>	11.88 (1.0) <sup>a</sup>
Layoff rate (average monthly rate)	1.68	1.08
s.d.	1.22	.87
New hire rate (addition of 12 monthly rates)	26.65 (2.2) <sup>a</sup>	46.80 (3.9) <sup>a</sup>
s.d.	10.14 ( .8) <sup>a</sup>	15.18 (1.3) <sup>a</sup>
Per cent of work force with 6 months or less job tenure	11.0	14.0
s.d.	3.8	3.5

<sup>a</sup> In parentheses the rate is expressed as a monthly rate. The new hire rate for 1966 in the sample was actually an average monthly rate converted to an annual rate by multiplying by 12.

tries relative to opportunities in one's own industry, and thus come into conflict with other measures of alternative job opportunities; note the high correlation with the layoff rate. Furthermore, as long as some industries have a seasonal pattern to their employment volume, then by necessity the new hire rate and the layoff rate are going to be related, the direction of causality not being at all clear.

All this is to explain why we do present the results of the exercise without further discussion of the coefficients and their significance. The likelihood that we have identified any of the coefficients is so small<sup>12</sup> that we have preferred to discount them completely even though the proportion of the variance of the quit rate "explained" is high enough to tempt anyone into error.

### *Relative Importance of Variables*

The regression coefficients presented so far measure the average number of units change in the dependent variable which occur with each increase of a unit of the independent variables. Their size depends not only on the relation between the independent variables and the quit rate

<sup>12</sup> Note, for example, that the substitution of the new hire rate for the per cent with brief job tenure reverses the sign of the coefficient of the layoff rate—a very dubious result, to say the least.



but also on the units in which the variables are measured. They may be made more comparable by expressing each variable in terms of its own standard deviation, using beta coefficients (sometimes called standard regression coefficients). These express the effect of a change of one standard deviation in the independent variable on the dependent variable, the effect being expressed in standard deviations of the dependent variable. These we present for only those variables for which the coefficients have a plausibility of statistical significance<sup>13</sup> in Table 3.

Unfortunately, this concept of "relative importance" is not unambiguous because the standard deviation of the variables expressed as a per cent of the means is likely to vary from variable to variable. In our case, the percentages vary from 8.65 to 80.89. One might plausibly ask oneself an alternative question: what is the effect of a one per cent change in the independent variable (from the mean) on the per cent change of the dependent variable (from the mean) on the average (elasticity of quits with respect to independent variable evaluated at the means).<sup>14</sup> This measure of "relative importance" is also recorded in Table 3 for the variables with statistically significant coefficients.

Comparing these two measure of "relative importance" brings out the fact that the results do not agree on relative magnitudes, and even not on relative order for 1963. It simply means that the reader is asked to choose his specific question and then answer it appropriately by consulting Table 3. For 1966 the relative order of importance stays the same with both measures. That order is, in decreasing importance: (1) the quality of the work force, (2) the wage level corrected for quality, (3) the percentage increase in earnings over the last three years, (4) the union occupancy rate, (5) the per cent with brief job tenure, and (6) the layoff rate.

### *The Size of the Effect of Rewards*

A recent OECD study proclaims that "One of the most significant findings of this study is that when the association between earnings levels and labour turnover is examined, it turns out to be consistently of negative sign, and with high and usually statistically significant values of the correlation coefficients. . . . The United States figures relating to quits (voluntary mobility) show a still stronger association than do those relating to total separations" [10, p. 52]. The main weakness of the whole study from which we are quoting is its quantitative method of analysis. The method consists of calculating literally thousands of simple correlation coefficients between variables relevant to the labor

<sup>13</sup>  $t > 1.30$ . No sense can be made of the concept of "relative importance" when the coefficients are not statistically significant.

<sup>14</sup> There is some difficulty in interpreting clearly this measure when the units of the independent variable are already percentage points (which is the fact for a number of our independent variables).

TABLE 5—SIMPLE AND PARTIAL REGRESSION COEFFICIENTS FOR THE REWARD VARIABLE

	1963	1966
<i>Average annual earnings corrected for skill mix:</i>		
Simple regression coefficient	-.00629	-.01188
<i>t</i>	(-7.22)	(-7.47)
<i>r</i>	-.714	-.726
Partial regression coefficient	-.00192	-.00592
<i>t</i>	(-1.66)	(-2.82)
<i>Average annual earnings not corrected for skill mix:</i>		
Simple regression coefficient	-.00422	-.00819
<i>t</i>	(-7.56)	(-8.33)
<i>r</i>	-.730	-.762
Partial regression coefficient	-.00198 <sup>a</sup>	-.00610 <sup>a</sup>
<i>t</i>	(-2.50)	(-3.88)

<sup>a</sup> Considerable doubt can be raised about these coefficients because uncorrected average annual earnings are highly correlated with the quality of the labor force,  $X_3$  ( $r = .824$ ).

market for a great number of countries, and testing their statistical significance. Not taken into account is the fact that the significance and even signs of the relationships easily can be changed if the independent variable is considered in conjunction with the set of independent variables that determine the dependent variable. Furthermore, the size of the simple correlation coefficient gives no indication of the size of the effect of the independent variable on the dependent one.

This weakness applies to the variables considered in the quotation as well. In order to compare our results with those of the OECD study, we have computed for our sample of 52 industries a number of simple linear regressions between the quit rate and earnings level, both adjusted and unadjusted for the quality of the work force; the OECD earnings levels are unadjusted for the skill mix. The results are reported in Table 5. All the signs of the association turn out to be negative, as expected. The interesting contrasts that can be noted are:

1. Using average annual earnings adjusted for the quality of the work force, the simple regression coefficient overestimates the effect of the level of rewards on quits by a factor of 3.2 for 1963 (-.00629/-0.00192) and by a factor of 2.0 for 1966 (-.01188/-0.00592).
2. Using average annual earnings unadjusted for the quality of the work force, the simple regression coefficients overestimate the size effect of the level of rewards on quits by a factor of 2.1 for 1963 and 1.3 for 1966.
3. The simple regression coefficient obtained from the unadjusted level of rewards overestimates the effect of the level of rewards adjusted for skill mix by a factor of 2.2 for 1963 (-.00422/-0.00192) and by a factor of 1.4 for 1966 (-.00819/-0.00592).

The effect of level of rewards on the quit rate, although considerably overestimated in simple regressions, is still sizeable in the multiple linear regression of our analysis. In our sample for 1966, the mean annual level of rewards (corrected for skill mix) in the 52 industries is \$5,429 with a standard deviation of \$726, and the mean quit rate (unweighted) is 29.92 per cent on an annual basis. Using the 1966 partial regression coefficient of level of rewards ( $-.00592$ ), we can say that a positive standard deviation in rewards (\$726) has the effect of reducing the quit rate by 4.30 on an annual basis ( $\$726 \times .00592$ ). Or put differently, around the means, a 1 per cent increase in rewards has the effect of reducing the quit rate by 1.08 per cent.

### *Final Remarks*

Subject to the important constraints imposed by the unavailability of quit rate data at the establishment level as distinct from the industry level, the statistical analysis presented above lends considerable support to the hypothesis about the quit rate proposed at the beginning. Particularly worth emphasizing is the fact that when business conditions are good, monetary rewards, in the form of level and rate of change, have a sizeable effect in prompting workers to stay or not to stay with their employers. Coupled with Rice's findings to the effect "that wage supplement expenditures vary systematically with money earnings" [6, p. 592], confidence is increased in the allocative role assigned to voluntary mobility by orthodox economic theory.

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# INTERNATIONALLY DIVERSIFIED PORTFOLIOS: WELFARE GAINS AND CAPITAL FLOWS

By HERBERT G. GRUBEL\*

The models of portfolio balance developed by Markowitz [5] and Tobin [8] explain the real world phenomenon of diversified asset holdings elegantly and properly. The models have been criticized, extended, and empirically tested; by now their basic content has become economic orthodoxy. Strangely, however, the analysis has not yet been applied explicitly to the explanation of long-term asset holdings that include claims denominated in foreign currency.<sup>1</sup>

The present paper fills this gap and yields some interesting results. First, the international diversification of portfolios is the source of an entirely new kind of world welfare gains from international economic relations, different from both the traditional "gains from trade" and increased productivity flowing from the migration of the factors of production. This specific theoretical proposition is illustrated with some calculations based on empirical data drawing on *ex post* realized rates of return from investment in 11 major stock markets of the world.

Second, the theoretical model shows that international capital movements are a function not only of interest rate differentials but also of rates of growth in total asset holdings in two countries. As a result, capital may flow between countries when interest rate differentials are zero or negative and may not flow when a positive interest differential exists. Third, the analysis has some important policy implications in a growing world where monetary and fiscal policies are mixed to achieve internal and external balance.

## I. *The Static Model*

Consider a world consisting of two countries, A and B, each with independent monetary and fiscal authorities and initially economically isolated from each other. Populations, income, and wealth are constant through time. There are only three forms of holding wealth: real assets, money, and bonds. The latter are issued by the government to provide investors with an interest-bearing instrument that allows bridging individuals' periods of net savings and dissavings over their lifetimes. In addition, the quantity of bonds in the market and the interest rate they

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<sup>1</sup> The importance of the real world phenomenon is exemplified by the recent report in [10].

fetch are regulated by the government in such a manner as to maintain full employment. For example, if there is unemployment, the government purchases bonds, paying for them with newly issued money. As a result of the increased money holdings and the lower yield of bonds, real assets are relatively more attractive than money and bonds and individuals try to adjust their portfolio imbalance through the purchase of more real assets, which has the desired upward effect on employment.

Assume that initially domestic portfolio balance exists at interest rates on bonds of  $R_A$  and  $R_B$ , and variances and covariances of returns of  $\sigma_A^2$ ,  $\sigma_B^2$ ,  $\sigma_{A,B}$ , where the subscripts  $A$  and  $B$  refer to the two countries and are measured from the point of view of Country A. That is  $R_B$ ,  $\sigma_B^2$ , and  $\sigma_{A,B}$  include an adjustment for exchange risk stemming from past variations in some shadow price of foreign exchange. Furthermore, assume for analytical convenience that when economic relations between the two countries are opened up only bonds and consumer goods can be exchanged so that the opening of trade does not affect the return and variance from holding real assets and money. Consequently, attention can be focused on the changes in bond holdings resulting from the opening of trade.

Before trade the expected rate of return  $E(R_A)$  and risk  $V(R_A)$  on the "average" investor's bond portfolio in Country A and B are:

$$(1) \quad E(R_A) = R_A$$

$$(2) \quad V(R_A) = \sigma_A^2$$

$$(3) \quad E(R_B) = R_B$$

$$(4) \quad V(R_B) = \sigma_B^2$$

After diversification a portfolio containing bonds of both Countries A and B has the following expected rate of return:

$$(5) \quad E(R_{A,B}) = P_A R_A + P_B R_B$$

Where  $P_A$  and  $P_B$  are the proportions of bonds of country A and B respectively held in the average portfolio of Country A,  $P_A$  plus  $P_B$  must sum to one and neither may be negative. The variance of the diversified portfolio is

$$(6) \quad V(R_{A,B}) = P_A^2 \sigma_A^2 + 2P_A P_B \sigma_{A,B} + P_B^2 \sigma_B^2$$

As the two equations show, investors have the opportunity to choose from a whole range of combinations of expected rates of return and variance by picking the appropriate sizes of  $P_A$  and  $P_B$ . Which specific combinations of risk and return they choose depends on their personal preferences, as has been demonstrated by Markowitz [5] and Tobin [8].

While the exact diversification is not important for the present pur-

poses of analysis, it is useful to demonstrate with the help of a numerical example that diversification results in portfolios superior to one-asset portfolios of either kind of bonds.<sup>2</sup> Assume that  $R_A = R_B = 5$  per cent. Therefore, before trade,  $E(R_A) = E(R_B) = 5$ . Diversification of the nature  $P_A = P_B = .5$  yields an expected rate of return:

$$(7) \quad E(R_{A,B}) = E(R_{B,A}) = 5$$

Assume that the variances of expected returns on Country A and B's properly adjusted for exchange rate fluctuations are  $\sigma_A^2 = \sigma_B^2 = 10$ , with a correlation between the two rates of return of  $r = .3$ . The variances on undiversified portfolios are  $V(R_A) = V(R_B) = 10$  but the variance on the portfolio containing both assets is

$$(8) \quad V(R_{A,B}) = 6.5$$

Thus, holding both assets does not change the expected rate of return but does reduce the riskiness of the portfolio as compared with the one-asset portfolio. By similar calculations and data it can be shown that the exchange of financial assets can lead to higher expected rates of return with equal risks and other combinations of returns and risks, all of which are superior to those from undiversified portfolios and, therefore, make the holders of wealth better off than they were without the opportunity for international diversification. The same principles apply to the residents of Country A and Country B.

The quantity of foreign bonds demanded by the residents of Country A and Country B after the opening of trade in this model depends on five primary factors. First, the size of total wealth assets held by the public: Since the variables  $P_A$  and  $P_B$  represent proportions, the absolute size of bond holdings is greater the greater the stock to which these proportions are applied.

Second, the size of the interest rate differential: Given the variances and covariance of the two-asset returns for any risk avoider, the trade-off between return and risk is more favorable the greater the foreign interest rate and, therefore, the more of the foreign asset will be held in the portfolio. Third, the size of the risk differential: For a given earnings differential and covariance of returns the foreign asset is more attractive the smaller the risk attached to it, given the riskiness of the domestic asset.

Fourth, the degree of correlation of returns on domestic and foreign assets: As can be seen from equation (6) the variance of a diversified

<sup>2</sup> The discussion of circumstances under which diversification does not take place, i.e., investors are risk lovers, domination of assets, perfect correlation of returns, etc., go beyond the scope of this paper and it is assumed that investors and assets in both countries meet the necessary requirements for diversification to take place.

portfolio is smaller the smaller the correlation of returns. Thus, given the earnings differential and variance of each asset independently, diversification reduces portfolio variance more and, therefore, is more desirable the smaller the covariance. Fifth, the tastes of the public: The combination of risk and return actually chosen from among the combinations made possible by diversification depends on wealth holders' preferences with respect to risk and return and current vs. future consumption.

Given the magnitudes of the five determinants of the demand for foreign bonds, the opening up of economic relations between the two countries is assumed to lead to a mutual exchange of bonds by the private wealth holders. Only if tastes, returns, variances and relative sizes of total wealth holdings are equal are the demands generated by each country equal. In the following analysis the empirically most relevant and theoretically most interesting assumption is made that the potential demand for foreign bonds by the residents of Country A exceeds that by the residents of Country B. The real effects of such a net excess demand are analyzed first, under the assumption of rigidly pegged exchange rates, and second, under the assumption of perfectly flexible exchange rates.

First, at pegged rates Country A's excess demand for bonds tends to depress its exchange rate and official sales of B's currency are required to keep it stable. We assume that the government of A obtains this foreign exchange from the government of B in return for its official IOU's.

When international relations are opened, the private residents of A sell off some of the bonds issued by their own government and acquire those of Country B. Some of A's bonds thus offered are purchased by residents of Country B, but under the present assumption of an excess demand for bonds by Country A, that government must purchase some of its old obligations to maintain aggregate portfolio balance and full employment. At the same time B's government issues a net supply of new bonds to the residents of A.

All of these changes in the balance sheets of governments and private wealth holders are completed a certain time after opening of international relations. The length of the adjustment depends on institutional arrangements in the bond markets and is not important for the present analysis. In the new equilibrium the excess demand for foreign exchange ceases and along with it the need for official intervention.<sup>3</sup> The excess demand by Country A's residents has caused the government of A to be indebted to the government of B rather than to its own citizens. B's

<sup>3</sup> The lower the risk or higher the return on bond holdings in both countries, the more likely an increase in the total demand for assets. Under these circumstances, savings will increase, causing a fall in the interest rate and requiring changes in employment policy. We neglect these effects by assuming that they are likely to be small. On the same grounds we disregard balance of payments and income problems arising from net interest payments.

government finds its obligation to A's private citizens matched by claims on A's government.

At no time between the two points of asset equilibrium did the exchange rate move and since full employment in both countries has been maintained there have been no income or price effects on the balance of trade and no real resources transferred between the two countries. The new pattern of asset holdings involves a net transfer of resources only if the interest rate on the official IOU's issued by government A and held by government B is different from that paid on the bonds issued by government B and held by the public in A, assuming equal liquidity and other service yields on each type and assuming equal taxation rates.

Second, under flexible exchange rates the net demand for B's bonds causes a lowering of A's exchange rate, the appearance of a balance of trade surplus for A, which persists until real resources equal in value to A's excess demand for bonds is realized. Then the exchange rate returns to its previous level under the present assumptions of a static world.

Assuming that neither government changes the quantity of its bonds outstanding, the net demand for B's bonds from the residents of A tends to raise the prices and lower the yields on B's bonds, inducing the residents of B to substitute real assets transferred from A for these bonds in their portfolios. There is a tendency for the return on real capital to fall in B and rise in A, reducing what *ceteris paribus* would have been the net excess demand for bonds in A. However, given the other determinants of this demand, total asset holdings and tastes, there is no necessity for this net asset demand to be moved to zero.

As long as the interest rate paid by Country B on the bonds held by the residents of A is equal to the marginal productivity of the resources transferred to B, the real income in both countries is the same as before the opening of international relations, except for the welfare gains accruing to the wealth holders from the diversification of their portfolios.

The model just presented gives rise to the possibility that real capital flows away from the country with the higher to the one with lower physical productivity of capital. Such an event occurs if the size of total asset portfolios in Country A is greater than that in Country B so that even at the initial interest rate differential in favor of A a net demand for B's bonds is created. Under flexible exchange rates these conditions result in a transfer of real resources to Country B through the process described in the preceding paragraphs.

It is clear that the welfare gains accruing to wealth holders through international diversification of their portfolios are different in nature from those known from the traditional literature in international economics, i.e., the Ricardo-Heckscher-Ohlin gains from trade and the classical gains from factors moving to higher productivity employment.



## II. Some Empirical Estimates of Potential Gains From Diversification

In order to demonstrate the range of possible gains to American investors from international diversification of their portfolios, information on rates of return from portfolio-investment in common stock market averages of 11 major countries (see Table 1) was collected, covering the

TABLE 1—RATES OF RETURN AND STANDARD DEVIATION FROM INVESTING IN FOREIGN CAPITAL MARKET AVERAGES  
1959-1966

	Per cent Per Annum (1)	Value of \$100 at End of Period (2)	Standard Deviation (3)	Correlation (R) with USA (4)
USA	7.54	178.92	47.26	1.0000
Canada	5.95	158.82	41.19	0.7025*
United Kingdom	9.59	208.00	65.28	0.2414*
West Germany	7.32	175.95	94.69	0.3008*
France	4.27	139.69	49.60	0.1938*
Italy	8.12	186.74	103.33	0.1465
Belgium	1.09	109.02	37.56	0.1080
Netherlands	5.14	149.33	86.34	0.2107*
Japan	16.54	340.21	92.52	0.1149
Australia	9.44	205.75	34.87	0.0585
South Africa	8.47	191.60	61.92	-0.1620

\* Statistically significant at the 5 per cent level.

Note: For computational methods see text.

Sources: The share price index for the United States is Moody's industrial average of common stocks from *Moody's Indus. Manual*, June 1967. The share price index for Canada is the industrial series from the Toronto Stock Exchange Supplement Booklet No. 2, the Toronto Stock Exchange, Jan. 15, 1966.

The share price indices for the United Kingdom, West Germany, France, Italy, Belgium, and the Netherlands are from the industrial series of the *Allgemeines Stat. Bull.*, European Economic Communities, various issues. The share price indices for Japan and Australia are industrial series from *Internat. Fin. Stat.*, International Monetary Fund, various issues. The price index for South Africa is a gold mining shares index from the *Quart. Bull.*, South Africa Reserve Bank, various issues.

The industrial dividend yields for the United States are from *Moody's Indus. Manual*, June 1967. The dividend yield on industrials series for the United Kingdom, West Germany, France, Italy, and the Netherlands are from *Allgemeines Stat. Bull.*, European Economic Communities, various issues; for Belgium, from personal correspondence with the Dredietbank; for Japan, from *The Oriental Economist*, various issues; for Australia, from personal correspondence with the Reserve Bank of Australia; for Canada, from one published by Moss Lawson and adapted to the Toronto Stock Exchange Industrial Index, from personal correspondence with the Toronto Stock Exchange.

The dividend yield on gold mining shares series for South Africa is from personal correspondence with the South Africa Reserve Bank.

The exchange rates for all countries are taken from *Internat. Fin. Stat.*, International Monetary Fund, various issues.

period from January 1959 to December 1966.<sup>4</sup> For each of these eleven markets the following monthly observations were obtained: Indexes of common share prices ( $P$ ), dividend yields on the shares in the index ( $Y$ ) expressed as per cent per year, and the dollar exchange rate ( $X$ ), defined as the price of one dollar. Subscripts 0 and 1 used below refer to the beginning and end of each monthly investment period; the share price index and exchange rate at the end of the current month is considered to be the price at which the next month's investment is made.

The monthly rates of return were calculated on the basis of the following considerations. The dollar price of one foreign stock market index unit is  $PE_0 = P_0/X_0$ . The dollar value of the investment at the end of the first month, ( $VE_1$ ), is equal to the foreign currency value of dividends received  $DP_1 = P_0Y_0/12$  plus the foreign currency value of one unit of the index at the end of the month ( $P_1$ ) converted to dollars at the exchange rate ( $X_1$ ), i.e.,

$$(9) \quad VE_1 = [(P_0Y_0)/12 + P_1]/X_1$$

The problem then becomes to find the solution value for  $r_1$  in the equation

$$(10) \quad VE_1 = PE_0(1 + r)^{1/12}$$

which after some manipulation and substitution becomes

$$(11) \quad r_1 = \left[ \left( Y_0/12 + \frac{P_1}{P_0} \right) \left( \frac{X_0}{X_1} \right) \right]^{12} - 1.0$$

A matrix of correlation among the eleven countries' monthly returns was computed and the variances and covariances were used in the subsequent calculations. Average rates of return were computed by taking the geometric mean of 95 monthly rates:<sup>5</sup>

$$(12) \quad R = \left[ \prod_{i=1}^{95} (1 + r_i) \right]^{1/12} - 1.0$$

This formula, thus, computes the annual rate of return from capital gains due to common stock price and exchange rate changes, under the assumption that dividends are reinvested each month in fractional shares at current prices and that interest is compounded annually. No adjustments were made for withholding taxes on income or transactions

<sup>4</sup> January 1959 was chosen as a starting point because in December 1958 European currencies became convertible *de jure*. Common stocks rather than bonds were analyzed because of the greater variance around the average returns and across countries found in the former. The theoretical analysis can easily be modified to account for foreign stock purchases.

<sup>5</sup> Taking the simple arithmetic mean of the monthly rates vastly overstates the value of the capital gains between the beginning and the end of the period plus the value of the dividends. For a discussion of the biases inherent in the calculation of indices and averages see [1].

costs. It should also be noted that exchange rate variations are assumed to be the only risks attached to foreign investment. Risks on foreign investment stemming from war, confiscation and exchange restrictions could not be quantified and were disregarded. Consequently the variances used in the subsequent calculations understate foreign risk and the estimates of gains from diversification are biased upward.

The empirical calculations are unrealistic in one other important respect. Due to indivisibilities, transactions costs, and limited portfolio sizes, it is virtually impossible for anyone to hold portfolios containing all of the shares making up the indices used in the calculations. Because the portfolio variance decreases with the number of individual stocks held, the underestimate of variance available to investors implicit in the calculation procedure is smaller the more diversified portfolios are in the real world. In general, the bias may not be too large in view of the availability of mutual funds in most of the foreign markets, though more empirical information on the investment patterns, transactions costs, etc., of these funds is needed.

In Table 1, column (1) shows average rates of return calculated in the manner just discussed while column (2) shows the capital value in December of 1966 of \$100 invested in January of 1959. Columns (3) and (4) report the standard deviation of monthly returns and the correlation of these fluctuations with those of Moody's industrial average of common stocks. As can be seen, the U. S. yield has been the sixth lowest, but the riskiness of the investment as measured by variance has been the fourth lowest.

Given these historic rates of return and interdependencies of the national stock markets, it is possible to compute rates of return and variances of portfolios which would have accrued to investors who had purchased foreign assets in various combinations. The most interesting of these combinations are those which for any given variance maximize the return. Portfolios which have these characteristics and are attainable with the available set of assets can be found through methods of quadratic programming, for which standard computer algorithms are available.<sup>6</sup>

Table 2 presents the results of two different calculations for efficient sets of internationally diversified portfolios. Part A is based on rates of return and variances of the eleven industrialized countries mentioned before, while Part B is restricted to the data of the eight countries of the Atlantic Community. The eight portfolios shown for each case are so-called corner portfolios, i.e., those at which further reduction in variance

<sup>6</sup> The program used is available in SHARE program under the code RSQPE4. It has been developed by the RAND Corporation. Finding the efficient set for 11 assets required 124 seconds on the IBM 7040. For the 8 assets the time requirement was 65 seconds.

TABLE 2—EFFICIENT INTERNATIONALLY DIVERSIFIED PORTFOLIOS

Percentage of Portfolio Invested in Country Portfolio Number								
Part A: Eleven Industrial Countries								
Country:	1	2	3	4	5	6	7	8
United States						12.3	12.8	12.5
Canada							14.0	15.9
United Kingdom		2.4	6.3	11.9	12.0	10.7	8.4	7.6
West Germany								
France								2.7
Italy					0.2	1.7	1.7	1.5
Belgium								
Netherlands								
Japan	100.0	97.6	74.9	32.1	30.8	17.0	8.5	7.0
Australia			18.9	42.6	43.1	42.6	39.0	37.3
South Africa				13.4	13.8	15.7	15.6	15.4
Portfolio Return	16.54	16.37	14.76	11.61	11.50	10.25	9.15	8.84
Portfolio Stand. Dev.	92.62	90.55	71.02	37.12	36.26	27.37	22.82	22.09
Part B: Atlantic Community Countries								
Country:	1	2	3	4	5	6	7	8
United States			26.6	42.9	35.7	32.1	29.5	16.4
Canada					21.3	24.9	27.3	25.4
United Kingdom	100.0	90.8	63.4	43.3	31.0	26.0	22.4	8.5
West Germany				4.7	5.0	4.3	3.6	
France						6.8	11.1	12.9
Italy		9.2	9.9	9.2	7.1	5.8	5.0	1.3
Belgium								34.4
Netherlands							1.1	1.2
Portfolio Return	9.59	9.45	8.90	8.47	7.87	7.48	7.20	4.65
Portfolio Stand. Dev.	65.28	60.63	46.67	39.76	34.49	32.23	30.96	25.10

*Notes:* For computational method see text.

*Sources:* Same as Table 1.

can be achieved only through the inclusion or omission of additional assets. The rates of returns and standard deviations for the corner portfolios are shown in the last two rows of Parts A and B of Table 2 and are plotted in Figure 1.<sup>7</sup> Other attainable combinations of return and standard deviations can be found by interpolation between corner portfolios, as is done by the lines drawn between the points in Figure 1.

As can be seen, diversification among the assets from the eleven countries in general would have permitted investors to attain higher rates of return or lower variance of their portfolios than they could have by purchasing a portfolio consisting of Moody's industrial average of common stocks. Which combination of assets given investors would in fact

<sup>7</sup> In the plotting of the data it was more efficient to use standard deviations rather than variances. Throughout this section the two terms are used interchangeably since this leaves substantive conclusions unaffected but facilitates exposition.

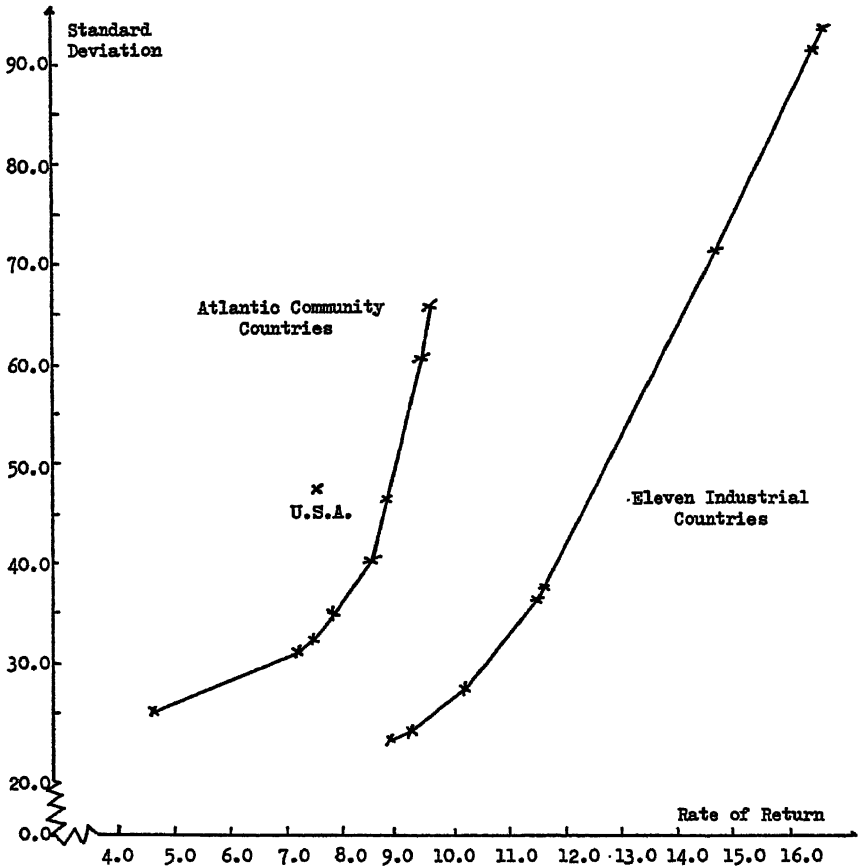


FIGURE 1. EFFICIENT PORTFOLIOS

have chosen cannot be known since it depends on their individual marginal rate of substitution between risk and return. It can be said unambiguously, however, that if an investor had wanted to maintain the same variability in return found in the New York investment, international diversification would have permitted him to earn 12.6 per cent as against 7.5 per cent, a gain of 68.0 per cent in the annual rate of return. When the opportunities for investment in Japan, South Africa, and Australia are excluded from consideration, the opportunity for gains from diversification are reduced considerably, as can be seen from Part B of Table 2, and the appropriate efficiency frontier in Figure 1. However, the increase in return attainable at the New York variance is from 7.5 per cent to 8.9 per cent, a gain of 18.7 per cent. As can be seen from

Table 2, Part B, Column 3, such a portfolio would consist of the following approximate investments: 26.6 per cent in New York, 63.4 per cent in London and 9.9 per cent in Italy.

Analogous calculations can be carried out to demonstrate the reduction in variance attainable by investing in internationally diversified portfolios with the same expected rate of return as that from investment in New York alone. Such calculations are not shown here; rough estimates can be made by inspection of Figure 1.

In general, the preceding analysis and calculations suggest that recent experience with foreign investment returns would have given rise to substantial gains in welfare to wealth holders. If past experiences are considered to be indicative of future developments, then these data suggest that future international diversification of portfolios is profitable and that more of it will take place.<sup>8</sup>

### III. *The Dynamic Model*

Some interesting conclusions from the model of internationally diversified portfolios result from the assumption that assets in both countries are growing through time. To simplify the analysis it is assumed that growth occurs in perfect balance, i.e., that income and assets in various forms grow at the same rate  $r_a$  and  $r_b$  for countries A and B respectively, and that exchange rates are pegged rigidly. If  $Q^0_{A,B}$  and  $Q^0_{B,A}$  are the initial stocks of foreign assets held in static equilibrium in Countries A and B respectively, then the gross flows ( $\dot{Q}^t$ ) at any point in time  $t$  are:

$$(13) \quad \dot{Q}^t_{A,B} = r_a e^{r_a t} Q^0_{A,B}$$

$$(14) \quad \dot{Q}^t_{B,A} = r_b e^{r_b t} Q^0_{B,A}$$

and the net flow from A to B ( $\dot{N}^t_{A,B}$ ) is

$$(15) \quad \dot{N}^t_{A,B} = r_a e^{r_a t} Q^0_{A,B} - r_b e^{r_b t} Q^0_{B,A}$$

Thus, it can be seen that the net flows of bonds between the two countries is a function of the growth rates and the size of the initial stocks in both countries. It is recalled that the initial stocks are determined primarily by the relative sizes of the two countries' wealth holdings and the existing interest rate differential.

Because of these determinants of bond flows, we have the following

<sup>8</sup> The validity of this statement depends on the interpretation of the results. One could argue that U.S. investors are in equilibrium and that the measures of risk used in the calculations represent an underestimate, which if properly accounted for would show little advantage to be gained from diversification. On the other hand, one could also argue that the calculations show the existence of a disequilibrium, that in fact U.S. investors are in the process of making stock adjustments which are taking time to accomplish. See Part V and footnote 10 for more comments on this possibility.

interesting possibilities. First, *gross* capital flows can occur between countries even if interest rates differentials are zero at all times. This is true whenever initial stocks of foreign bonds and growth rates are positive. Second, net capital flows into the low interest country (assumed to be Country A) can take place when first,  $r_a > r_b$  and  $Q^0_{A,B} = Q^0_{B,A}$ ; second,  $Q^0_{A,B} > Q^0_{B,A}$  and  $r_a = r_b$ ; third,  $r_a > r_b$  and  $Q^0_{A,B} > Q^0_{B,A}$ ; fourth,  $r_a < r_b$  and  $Q^0_{A,B} > Q^0_{B,A}$ . In the last two cases, however, the net flow to Country A occurs only if the growth effect outweighs the stock effect or vice versa.

Under the assumed system of fixed exchange rates there are no equilibrating forces set into motion by *net* bond flows as long as the government of the country selling the private bonds is willing to accept the other country's official I.O.U.'s in the manner described in Part I. In the long run, however, these stocks of official I.O.U.'s can become very large and it is doubtful that any governments are willing to accumulate them indefinitely. Pressures for a real transfer of resources will be generated and these will bring into being equilibrating forces.

The nature of these forces can be discerned most readily in the world of perfectly flexible exchange rates, where the net demand for bonds by residents of Country A results in the transfer of real resources to Country B through the generation of a trade surplus for A. This transfer has two effects. First, the rate of real economic growth in B increases while that in A decreases. Second, the marginal productivity of capital falls in B and rises in A. Both the real growth and interest rate effects tend to reduce the gross demand for bonds in A and raise the gross demand for bonds in B. The effects persist until gross bond flows have become equalized. However, such equality does not necessarily occur when the interest rate differential is zero. The differential can be either positive or negative and gross flows can remain equal as long as the products of growth rates times stocks of foreign assets are equal for both countries.

#### IV. *Interest Elasticity of Capital Flows*

In this part special attention is given to the role of interest rates in the preceding models, primarily because of some interesting policy conclusions following from the analysis.

In the static model after stock equilibrium has been established bonds cease to flow between the two countries. However, the potential for flows in response to interest rate changes is always present. Thus, if for some domestic policy purpose Country A decides to lower its interest rate, foreigners will decrease their holdings of Country A's bonds and domestic wealth holders will increase their holdings of foreign bonds. The result is a net demand for bonds by Country A which leads to a transfer of I.O.U.'s to the government of B or to the transfer of real resources

in the manner discussed above. However, it is important to note that in this static model the flow of capital following the interest rate change is a once-and-for-all stock adjustment, which is accomplished within a certain time period, the length of which depends on institutional characteristics of the bond market.

In the dynamic version of the model the change in the interest rate differential calls forth the equivalent of a stock adjustment flow which is superimposed on the flow due to portfolio growth. The duration of this stock-adjustment flow component depends on the institutional characteristics of the bond market, as in the static model. After completion of the stock adjustment flow, the regular transfer of bonds continues to grow at the same rate as before, but the level is different. These points can also be made with the help of the accompanying Figure 2.

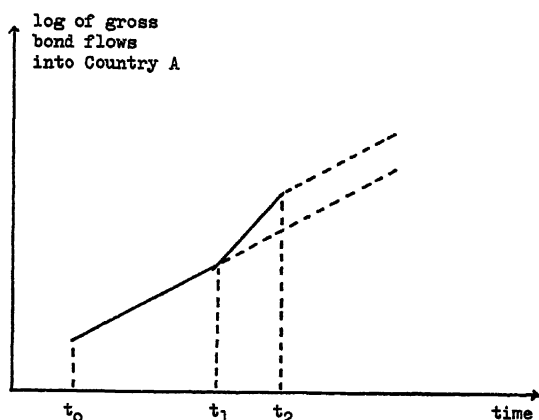


FIGURE 2

On the horizontal axis we plot time, on the vertical axis the log of gross capital flows from B to A. The line segment  $t_0 t_1$  has a slope  $r_a$ , equal to the rate of growth of wealth portfolios in Country A. At period  $t_1$ , Country A lowers its interest rate and the growth rate of foreign bond holdings in A increases, as is shown by the steeper slope of the line segment  $t_1 t_2$ . After the completion of the stock-adjustment process, the rate of growth in foreign bond holdings returns to its old level  $r_a$  but the *level* of bond holdings is raised at any given moment in time by the vertical distance between the solid and broken growth lines as a result of the increased rate differential.

### V. Some Implications of the Model

First, the classical theory of factor movements considers rates of return alone as the determinants of international capital flows. In its basic



form, therefore, it cannot explain the real world phenomenon of simultaneous European investments in the United States and U.S. investments in Europe. Direct investment of this nature has been explained as resulting from the cost conditions in oligopolistic industries [2]. The present model provides an additional explanation that is especially applicable to the purchase of foreign bonds and other noncontrol conferring assets.

Second, the present model suggests that the empirical measurement of the interest elasticity of international capital movements can be improved by the inclusion of independent variables representing the growth in total asset portfolios and by studying gross flows of capital from each country. Consider, for example, the case where the interest rate differential is zero, gross flows are positive and large but net flows are zero. In our model it is possible that an increase in the rate of economic growth of one country causes the rise of that country's gross purchases of foreign assets and causes the appearance of a net flow even though the interest rate differential remained at zero.<sup>9</sup> A measurement of the interest elasticity of net flows would yield nonsensical results, but the measurement of gross flows and inclusion of total portfolio growth can explain the phenomenon.

Third, the model leads to the hypothesis that the large scale U.S. investments in Europe during the last decade are part of a stock adjustment phenomenon that started when European currencies became convertible *de jure* in 1958 after having been convertible *de facto* a few years earlier. If this hypothesis is correct, then there may eventually take place a slowdown in the rate of U.S. capital outflows to Western Europe.<sup>10</sup> However, because of the proportionately larger size of U.S. portfolios, normal growth in both continents leads to the expectation of a continued net demand for European assets. If this is so, European governments must either be willing to accept more of the U.S. government's I.O.U.'s or permit a greater trade surplus to occur if the free convertibility of the major Western currencies is to be maintained. Equalization of interest rates will be insufficient to equalize gross flows, because of the different sizes of total asset holdings in Europe and the United States.

Fourth, the portfolio model suggests that a once-and-for-all change in international interest rate differentials leads to only a once-and-for-all stock adjustment, after which gross flows return to their old levels. This implication of the portfolio model leads to an empirically important

<sup>9</sup> Harry G. Johnson has suggested a similar dependence of international capital flows on rates of economic growth in his [4].

<sup>10</sup> This point has also been made by J. Tobin [9, p. 168].

extension of the arguments over the proper mix of monetary and fiscal policy for the achievement of internal and external balance.

In Mundell's formulation of this argument [6] the domestic interest rate is set at such a level as to attract a quantity of foreign capital sufficient to fill the current account gap in international payments while fiscal policy is set at a level of restrictiveness sufficient to attain domestic full employment. Our model suggests that at the international interest rate differential initially chosen, there will be a stock-adjustment flow of a size that cannot be sustained beyond the attainment of the new stock equilibrium. If the external deficit on current account persists beyond this point of new stock equilibrium, then the interest rate differential has to be raised again to finance the deficit in the next period and so on until it is eliminated by some other policies. If foreign wealth holders run into diminishing returns to international diversification, then the subsequent increments to the interest differential have to be increasingly larger.<sup>11</sup>

Fifth, the model can be used to explain holding of foreign short-term assets as well as bonds, corporate securities, and direct investment. Continuous and growing international diversification demand for short-term assets has some interesting implications for U.S. balance of payments "deficits" under the liquidity definition. Even if the growing exchange of short-term assets between the United States and the rest of the world is perfectly balanced, the United States would show a continuous and growing balance of payments deficit since the foreign holdings of short-term dollar assets are considered to be a potential claim on U.S. reserves which the balance of payments statistics are designed to reflect. Yet, the model presented suggests that these potential liabilities are counterbalanced by U.S. holdings of foreign short-term assets and that the foreign asset demand is normal and permanent because of the continued welfare gains from holding internationally diversified portfolios. The model thus strengthens the arguments made against the use of the liquidity concept and in favor of the official-reserve-transactions concept.<sup>12</sup>

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<sup>12</sup> These issues have been analyzed in [7].

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# AN INCOME-NET WORTH APPROACH TO MEASURING ECONOMIC WELFARE

By BURTON A. WEISBROD AND W. LEE HANSEN\*

Economists and public policy-makers alike have long been concerned with the relative and absolute economic welfare of various segments of the population. This interest reflects an underlying concern both about the equity of the existing distribution and about our ability to explain and forecast more effectively the behavior of producers and consumers.<sup>1</sup> But given the many possible dimensions of a comprehensive measure of economic welfare, the single-dimensional, money-income measure so commonly used leaves much to be desired.

The concern of this paper is with the development of an approach for measuring current economic welfare which is operationally feasible and broader in scope than the traditional money-income measure. The measure proposed is based on a combination of current income and current net worth (assets minus liabilities). These are made commensurable by converting net worth into an annuity value, which is added to current income. While this proposed measure stops well short of an "ideal" measure, we show that even this change leads to policy prescriptions rather different from those generated by the current income measure of economic welfare.

## I. *The Measure*

The proposed measure rests on the assumption that current income and current net worth are both important determinants—although not the sole determinants—of the "economic position" of a consumer unit. A unit's economic well-being or economic position should be thought of as a function of the flow of services over which it has command. This flow depends importantly on the consumer unit's current income and also on the services it receives from its assets, net of liabilities.<sup>2</sup>

It is well known that the distribution of income and the distribution

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<sup>1</sup> There is a considerable literature on the measurement and extent of inequality in the size distribution of income. For a review of some of this work as well as for useful bibliographic references, see Irving B. Kravis [5]; and T. Paul Schultz [12].

<sup>2</sup> Of course, expected future income or "permanent" income is also relevant, particularly insofar as it may influence current access to capital markets. Although in our empirical work below we disregard expected future income, this variable certainly deserves further attention.

of net worth differ significantly.<sup>3</sup> Were it not for these differences—if the relative position of the various consumer units were more nearly identical in the two distributions—then it would be less important to attempt to integrate the two distributions. Such an integration would still be useful, however, if we wished to apply an absolute standard for determining the level of economic position, e.g., “affluence” or “poverty.”

Although data on income and net worth are frequently available, the two types of information have not been combined, presumably because income is a flow while net worth is a stock. The procedure we set forth involves converting net worth into an income flow by recognizing that it is translatable mathematically into an annuity.<sup>4</sup>

For any given consumer unit—individual, family or household—we propose measuring its “economic position,”  $Y^*$ , in time period  $t$ , as the sum of (1) its current annual income (the precise measure of income, which is net of yield on net worth, will be specified later),  $Y_t$ , and (2) the annual lifetime annuity value of its current net worth, expressed as  $NW_t \cdot A_n$ , where  $A_n$  is the value of an  $n$  year annuity whose present value is \$1.<sup>5</sup>

$$(1) \quad Y_t^* = Y_t + NW_t \cdot A_n.$$

$Y_t^*$  is, thus, the income obtainable in period  $t$  if the unit's net worth were converted so as to yield a lifetime flow.

The annuity value,  $NW_t \cdot A_n$ , is a function of the amount of net worth,  $NW_t$ , the life expectancy of the consumer unit, as denoted by  $n$ , and the rate of interest,  $r$ . Thus, for any given interest rate, the greater the net worth of the unit, and the shorter its life expectancy, the greater will be the annual annuity, and therefore the greater will be the difference between  $Y_t^*$  and  $Y_t$ . This suggests that the distribution of economic position by age will differ significantly depending on whether the combined income-net worth measure or the current income measure is used. In particular, since older people have higher ratios of net worth to current money income, as well as shorter life expectancies, their economic position will be most affected by the consideration of net worth.

In proposing our measure we are not implying either that people generally *do* purchase annuities with any or all of their net worth, that

<sup>3</sup> See Dorothy S. Projector and Gertrude S. Weiss [11]; and Harold F. Lydall and J. B. Lansing [7].

<sup>4</sup> The authors used this approach in examining the relevance of assets to the definition of “poverty,” in an unpublished memo (August, 1964) while staff members for the Council of Economic Advisers. The approach has also been used by Janet Murray [9]. Also see Projector and Weiss [11] for a somewhat similar approach.

$$\left( A_n = \frac{r}{1 - (1 + r)^{-n}} \right).$$

they necessarily *should* do so, or that they *can* do so. The problem of making income and net worth commensurable is conceptually independent of the practical possibilities for converting net worth into an annuity. For the fact is that, if our method of combining income and net worth is regarded as unsatisfactory—on the grounds that actual conversion is either difficult or undesirable—some other method is needed for combining them. It is hardly satisfactory to disregard net worth, and any measure of economic position which considers both necessarily implies some tradeoff between them.<sup>6</sup>

Before we turn to several applications of the income-net worth measure, it is useful to consider alternative periods over which net worth might be annuitized. At one extreme, net worth could be annuitized over an infinite period. Economic position would then be measured solely by current money income, since the annuity would consist entirely of interest, and that would be included in current money income. Thus, in effect,

$$(2) \quad Y_t^* = Y_t.$$

At the other extreme, economic position might be measured under the assumption that net worth is to be annuitized entirely during the current period;<sup>7</sup> this implies a measure of economic position:

$$(3) \quad Y_t^* = Y_t + NW_t,$$

where  $Y_t$  should be interpreted as net of the yield from net worth, since this yield would be lost if net worth were depleted in the current period. The alternative which we have used involves the assumption that net worth is to be annuitized over the expected lifetime of the consumer unit.<sup>8</sup> This decision, while arbitrary, is consistent with the spirit of much recent empirical research that suggests that saving (net worth accumulation) is in large part motivated by a desire to smooth out patterns of

<sup>6</sup> With regard to the practical aspects of conversion, there are some interesting issues which, however, are outside the bounds of this paper. For example, consider the net worth of older people, in the form of housing. They frequently prefer to continue occupying homes rather than relocating in smaller quarters more appropriate to their reduced family size; and although they may not be opposed to the idea of converting their homes into annuities by selling them and leasing them back, the market for such transactions seems quite undeveloped. We can only speculate as to why this sort of arrangement is so unusual. This market may have been simply overlooked by financial institutions. Alternatively, there may be no real demand for conversion of home equity into an annuity. In addition, it does seem that commercial annuities have paid very conservative rates of interest, and thus have been rather unattractive. Clearly, additional research into the operation of annuity markets is in order.

<sup>7</sup> This case is discussed by Martin David [3].

<sup>8</sup> There are still other alternatives. One is to assume that net worth is annuitized over some arbitrarily specified time period, such as the maximum time period consistent with raising  $Y_t^*$  by some specified level. For an example of this approach, see Projector and Weiss [11].

normal lifetime consumption and to build up reserves to take care of unanticipated needs arising from, for example, medical expenditures [4] [6].

A decision to annuitize all of a unit's net worth over its lifetime, or indeed over any shorter period, implies that no net worth will remain at the time of death of the unit. But if a portion of net worth should be regarded as being held in trust as an estate for the survivors or for others, then only the remaining portion of net worth should properly be annuitized.<sup>9</sup> In any case, a decision regarding the treatment of estates should be recognized as involving both a factual question of the extent to which people *do* save for estate purposes,<sup>10</sup> and a social value judgment regarding the desirability of intergenerational wealth transfers (at death and at other times)—that is, whether people *ought* to save for estate purposes, and how much they ought to save [4]. These issues clearly deserve more attention.

In the empirical work that follows we shall arbitrarily base our calculations on the assumption of lifetime annuitization of net worth with no estate exclusion. The approach presented is general enough, however, to embrace alternative assumptions regarding the period of annuitization and size of estate, and, indeed, whether all components of net worth should be included. When the phrase "income-net worth" is used in the remainder of this paper it refers to  $Y^*$ , in expression 1 above, with net worth being annuitized over the consumer unit's expected lifetime.

## II. Applications and Implications

Uses for the income-net worth measure of economic position are numerous, ranging from reassessment of the extent of economic inequality to use in predicting consumer behavior. In this section we focus, first, on the extent of economic inequality as indicated by the combined income-net worth measure of economic position for families, then touch upon the implications of the findings for government anti-poverty policy and for the definition of tax progressivity and regressivity, and, finally, venture a comment on the usefulness of the measure for the prediction of consumer expenditure behavior.

The basic sources of data for our income-net worth estimates of eco-

<sup>9</sup> If an estate of size  $E$  is desired at the time of "expected" death  $n$  years hence, then with an interest rate  $r$ , the amount of net worth available for conversion to an annuity at time  $t$  will be

$$NW_t = \frac{E}{(1+r)^n}$$

If, alternatively, it is desired to guarantee an estate no smaller than size  $E$  regardless of when death occurs, then the amount of net worth available for conversion to an annuity will be smaller, namely,  $NW_t - E$ .

<sup>10</sup> The fact that intergenerational transfers are so frequently made via the estate route rather than by transfers before death may be less an indication of people's desires to pass on their wealth than it is a reflection of their inability to anticipate the time of their death.

conomic position are the *Survey of Financial Characteristics of Consumers* (SFCC) and the *Current Population Survey* (CPS), for 1962. The SFCC provides data on families by age of head, income, and net worth<sup>11</sup>; the CPS provides data on family income by age of head, broken down into finer income classes. In view of the greater detail on income provided by the CPS data, and its larger sample size at the lower income levels, we chose to combine the SFCC data on net worth with the CPS data on income. Full details regarding the method of calculation are described in the Appendix to this paper obtainable from the authors upon request.

Briefly, the nature of the calculations employed to create the income-net worth measure of economic position are as follows. From the SFCC the median value of total net worth for families by income size class was determined.<sup>12</sup> It was then assumed that the net worth for this income class in the SFCC data was equivalent to the net worth for the same income class from the CPS data. However, since the income data already include a return from income-yielding assets, this return had to be deducted from income before the annuity value of net worth was added; otherwise there would have been double-counting of net worth.

We then determined the size of the lifetime annuity that total net worth could produce. In calculating the value of the annuity we used a 4 per cent and a 10 per cent interest rate, alternatively, to give a notion of the sensitivity of the results. In estimating joint life-expectancy values—the other component of the annuity calculation—we assumed that family heads (males) were five years older than their wives, and that the full annuity would be received while both husband and wife were alive but that the surviving spouse would receive two-thirds of the annuity during the remainder of his or her life.<sup>13</sup>

It is clear that a number of simplifying assumptions have been made in our empirical work. Consequently, our estimates should be regarded as somewhat rough, their principal objective being to illustrate our approach.<sup>14</sup>

<sup>11</sup> Net worth refers to all assets less all debts covered in the SFCC; the only important assets excluded were life insurance investments and equities in annuities and in retirement plans. Assets or wealth include the following: own home, automobile, business or profession (farm and nonfarm), liquid assets, investment assets, and miscellaneous assets. Debts include debt secured by own home, debt secured by investment assets, personal debt, and debt on life insurance policies. See [11].

<sup>12</sup> Median rather than mean net worth was used, in view of the highly skewed distribution of net worth holdings within income size classes. For further elaboration, see Appendix. The net worth data in the SFCC—unlike the CPS income data—did not distinguish between families and unrelated individuals as we would have preferred, except for the under \$3,000 income class. See Appendix for further discussion.

<sup>13</sup> Here we follow the approach used by Janet Murray [9].

<sup>14</sup> After this study was completed, the basic SFCC data tapes became available. We plan to use these data for additional applications of the income-net worth measure. Use of the basic data will eliminate the need for many of the assumptions made above and thus will provide a check of the adequacy of these estimates.



TABLE 1—PERCENTAGE DISTRIBUTION OF FAMILIES BY TWO MEASURES OF ECONOMIC POSITION, BY INCOME, 1962

Income Size Class	Percentage Distribution of Families		
	Current Money Income	Income-Net Worth	
		4 Per Cent	10 Per Cent
	(1)	(2)	(3)
Under \$3,000	20	18	17
3,000- 4,999	19	17	16
5,000- 7,499	27	25	24
7,500- 9,999	17	17	16
10,000-14,999	13	15	17
15,000-24,999	4	6	7
25,000 and over	1	2	3
Total	100	100	100
Median	\$5,960	\$6,480	\$6,750

Source: Column 1—See [14, Table 3, p. 26]. Columns 2, 3—Based upon data from [14, Table 3, p. 26] and [11]; see Appendix to this paper for method of calculation.

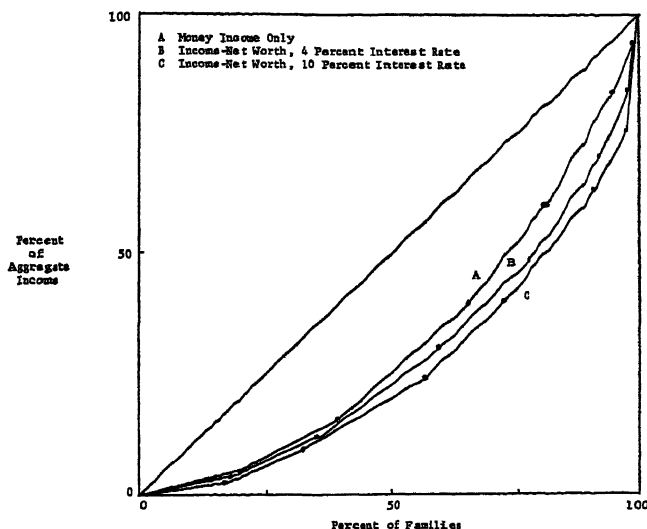
*Extent of economic inequality.* One important application of the income-net worth concept is to the measurement of economic position or of the extent of economic inequality. In this subsection we compare results obtained through use of the income-net worth measure with those obtained through use of the more conventional, current money income measure.

If economic position is measured by current money income, then the distribution of economic position of United States families in 1962 is as indicated in Table 1, column 1. It shows, for example, that 20 per cent of all families—9.3 million—were below \$3,000, and 18 per cent—8.3 million—were above \$10,000.

If, however, economic position is measured by the more comprehensive income-net worth measure, the entire distribution is shifted upward and its shape is altered, as is shown in Table 1, columns 2 and 3. By this measure, the fraction of all families whose economic position is below \$3,000 per year *falls* to 18 per cent at a 4 per cent rate of interest—a drop of nearly one million families—and to 17 per cent at a 10 per cent rate of interest—a drop of 1.4 million families. The fraction above \$10,000 *rises* to 23 and 27 per cent, respectively—increases of 2.2 to 4.2 million families. The median economic position, \$5,960 per year by the current income measure, also rises—to \$6,480 at a 4 per cent rate and \$6,750 at 10 per cent.

The shift in the entire distribution is portrayed by the Lorenz curves in Figure 1.<sup>15</sup> They indicate that the degree of inequality is greater by

<sup>15</sup> The Gini coefficients are as follows: for the income measure, 0.37; for the income-net worth measure at a 4 per cent interest rate, 0.42; and at a 10 per cent interest rate, 0.47.



Notes: None of the Lorenz curves cross.

FIGURE 1. LORENZ CURVES: PERCENTAGE SHARE OF INCOME AND INCOME-NET WORTH RECEIVED BY FAMILIES, 1962

the income-net worth measure than by the income measure alone. The greater inequality reflects the fact not only that net worth holdings are, on average, positive in all income classes specified, but also that, except for the lowest income class, the ratio of net worth to income rises with income, as shown in Table 2.<sup>16</sup>

TABLE 2—MEDIAN INCOME AND MEDIAN NET WORTH OF FAMILIES, BY INCOME, 1962

Income Size Class	Median Income	Median Net Worth	Ratio (2)/(1)
	(1)	(2)	(3)
Under \$3,000	\$ 1,780	\$ 2,250	1.3
3,000- 4,999	4,040	2,330	0.6
5,000- 7,499	6,170	5,560	0.9
7,500- 9,999	8,650	11,290	1.3
10,000-14,999	12,500 <sup>a</sup>	18,320	1.5
15,000-24,999	20,000 <sup>a</sup>	37,020	1.8
25,000 and over	N.A.	455,900	N.A.

N.A.—Not available.

<sup>a</sup> Estimated to be equal to the midpoints of the income class.

Sources: Column 1—See [14, Table 3, p. 26]. Column 2—See [11, Table A, pp. 96-97]; also see Appendix to this paper.

<sup>16</sup> The lowest-income class violates this generalization largely because it contains a higher proportion of aged—roughly one-third—than does the next-higher income class—for which the fraction is about one-fifth (calculated from Current Population Report [14]). This fact is significant because the aged (65 years and older) have a higher average ratio of net worth to income than do younger families; see Table 4, *infra*.

TABLE 3—MEDIAN INCOME, MEDIAN NET WORTH, AND LIFE EXPECTANCY OF FAMILIES, BY AGE OF FAMILY HEAD, 1962

Age of Family Head	Median Income	Median Net Worth	Ratio (2)/(1)	Family Life Expectancy (Years)*
	(1)	(2)	(3)	(4)
Under 35	\$5,585	\$ 759	.14	49
35-54	6,918	7,664	1.11	34
55-64	6,219	13,210	2.12	21
65 and over	3,204	9,719	3.03	11
All	\$5,956	\$ 8,329	1.40	

\* "Family life expectancy" is a weighted average of the life expectancies of husbands and wives at the mean age of the family head and on the assumption that wives are five years younger than their husbands. A weight of two-thirds is given to the additional years of life expectancy of the wife; this results from the assumption that widows will receive an annuity of two-thirds of the amount of the annuity previously received by the combined husband and wife unit.

Sources: Column 1—See [14, Table 3, p. 26]. Column 2—See [11, Table A 1, pp. 96-97]; also see Appendix to this paper. Column 4—Based upon data from [15]; see Appendix to this paper for method of calculation. (Appendix is available from authors.)

The effect of considering net worth in addition to income varies considerably with the age of the group, as noted earlier. This is illustrated in Table 3 which shows that the ratio of net worth to income rises dramatically with age, while life expectancy obviously decreases with age. Lorenz curves in Figure 2 for the four major age groups reveal clearly how the distributions of money income and of income-net worth diverge with age.<sup>17</sup>

This section establishes that the distribution of economic position by the proposed measure differs from that shown by current money income because of differences among age groups in life expectancies and in the relationship between income and net worth.<sup>18</sup> To further illustrate the

<sup>17</sup> The Gini coefficients for the income measure and the income-net worth measure based on a 10 per cent interest rate, are as follows:

Age of Family Head	Income	Income-Net Worth
Under age 35	0.31	0.34
35-54	0.34	0.43
55-64	0.39	0.50
65 and over	0.45	0.61

<sup>18</sup> Were we to use a more comprehensive measure of economic position that included *expected* income as well as current income—as we have said earlier would be desirable—the picture of the age distribution of economic position would be altered further. In particular, since the incomes of younger people can be expected to rise, their economic position will be improved in the future. For older persons, however, the opposite will more likely be the case since, if anything, their expected income path is declining rather than rising. We are planning to examine the possibilities of incorporating expected income into our measure.

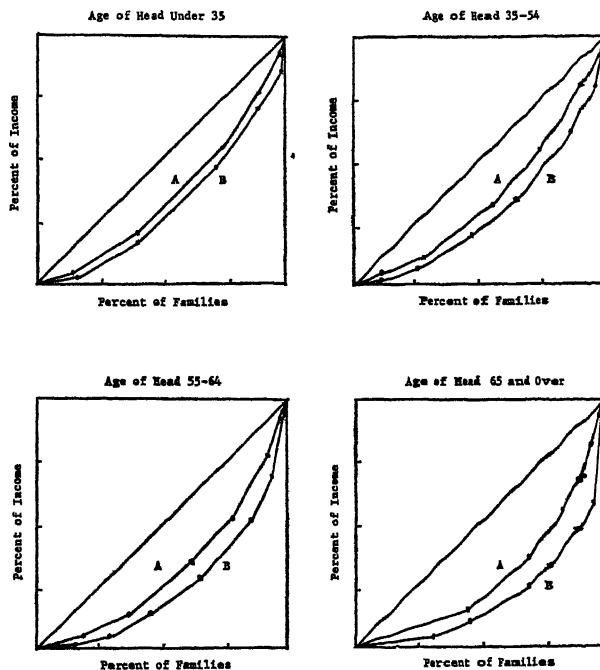


FIGURE 2. LORENZ CURVES: PERCENTAGE SHARES OF MONEY INCOME (A) AND INCOME NET-WORTH, AT A 10 PER CENT INTEREST RATE (B), RECEIVED BY FAMILIES, BY AGE OF HEAD, 1962

usefulness of the new measure we now examine the extreme low and high ends of the distribution of economic position.

*Implications for measurement of "poverty" and "affluence."* What impact does our measure of economic position have on the magnitude and age distribution of "poverty" in the United States? In answering this question we shall define the poverty line for families as \$3,000 of current income, or, alternatively, as \$3,000 of income-net worth per family. (Many an ideal measure of welfare would include many other variables.) One especially important limitation to either of these measures is that they fail to distinguish among families of diverse size. Family size is important in looking at the amount and composition of poverty among age groups, since there is considerable variation in size by age of family head. As Orshansky has shown [10], the family size adjustment reduces the total number of poor *families*, though it leaves the total number of poor *people* unchanged. The reduction in the number of poor families is particularly great among those headed by persons over 65, since the average size of these families is relatively small. For simplicity, we have used the now-antiquated \$3,000 poverty line. Our objective, in any case,

TABLE 4—NUMBERS AND PERCENTAGES OF FAMILIES WITH INCOMES AND INCOME-NET WORTH OF LESS THAN \$3,000 PER YEAR, AND OF MORE THAN \$10,000 PER YEAR, BY AGE OF HEAD, 1962

Age of Family Head	Less Than \$3,000 Per Year					
	Families With Current Money Income Below \$3,000		Families With Current Income—Net Worth Below \$3,000, at			
			4 Per Cent Interest Rate		10 Per Cent Interest Rate	
	Per Cent of All Families in Age Group	Number of Families (Millions)	Per Cent of All Families in Age Group	Number of Families (Millions)	Per Cent of All Families in Age Group	Number of Families (Millions)
Under 35	(1) 17	(2) 2.0	(3) 17	(4) 2.0	(5) 17	(6) 2.0
35-54	13	2.7	12	2.7	12	2.6
55-64	19	1.4	17	1.2	15	1.1
65 and over	47	3.2	36	2.4	32	2.2
All	20	9.3	18	8.4	17	8.0
Age of Family Head	More Than \$10,000 Per Year					
	Families With Current Money Income Over \$10,000		Families With Current Income—Net Worth Above \$10,000			
			4 Per Cent Interest Rate		10 Per Cent Interest Rate	
	Per Cent of All Families in Age Group	Number of Families (Millions)	Per Cent of All Families in Age Group	Number of Families (Millions)	Per Cent of All Families in Age Group	Number of Families (Millions)
Under 35	(1) 9	(2) 1.1	(3) 10	(4) 1.2	(5) 11	(6) 1.3
35-54	24	5.1	29	6.1	34	7.2
55-64	22	1.6	30	2.2	36	2.6
65 and over	9	0.6	16	1.0	21	1.4
All	18	8.3	23	10.5	27	12.5

Source: Same as Table 1.

is to emphasize not the absolute number of poor families but rather *changes* in that number and in the age composition when net worth is considered in addition to income.

The effect of using income-net worth rather than current income is shown in the top panel of Table 4. If current income is used alone to measure the extent of poverty, then—recognizing that no adjustment

has been made for family size—the table shows that 47 per cent of the aged are “poor.” When net worth is annuitized at a 4 per cent rate the percentage falls to 36, and to 32 at a 10 per cent rate.<sup>19</sup> A glance up the columns shows, again, the decreasing effect of net worth as successively younger families are considered. Thus, the “poverty problem” appears to be much less a problem of the aged when net worth is taken into account than is the case when current income alone is the criterion. Moreover, apart from the distribution of the “poor,” the total number of “poor” families falls, from 20 per cent—9.3 million families—to 17 per cent—8.0 million families—when net worth is considered (at a 10 per cent interest rate).

If we now look at the age distribution of poor families, we find that whereas the aged poor constituted 34 per cent of all poor families by the current income measure, they comprise only 28 per cent of all poor families according to the income-net worth measure. In absolute numbers, their total drops from 3.2 million to 2.2 million families. Consequently, the relative as well as the absolute number of the “aged poor” is substantially reduced. Again, the rising ratio of net worth to income with age, shown in the top panel of Table 5, coupled with the falling life expectancy, is of critical importance.

The question of how poverty should be measured for purposes of governmental policy remains open; it is certainly not resolved by our brief foray into the issue.<sup>20</sup> Illuminating, nonetheless, is the fact that the proposed income-net worth measure of economic position—by accounting for net worth and life expectancy as well as income—portrays a smaller magnitude of poverty, and a rather different age composition of the poor.

It might be argued that the more conventional measures of poverty, based on current income alone, have assumed *implicitly* some level of net worth holdings, or that they *ought* to have made such an assumption. If the income-net worth measure is viewed as useful, the question still re-

<sup>19</sup> A comparison of our results with those of Janet Murray [9] can be made only for families aged 65 and over with annual money income less than \$3,000—for only these aged families were examined in her study. By our income-net worth concept and at a 4 per cent interest rate, the number of aged poor is reduced by 23 per cent, i.e., from 47 to 36 per cent. The Social Security study also used a 4 per cent interest rate, but employed two income measures: income with prorated assets excluding home, and income with prorated assets including home. The first measure reduced the number of the aged poor by only 11 per cent; from 54 to 48 per cent. When homes were included among prorated assets, the number was reduced by over one-third, from 54 per cent to 35 per cent, i.e., a total reduction of 35 per cent. Differences in the underlying data as well as use of assets rather than net worth would appear to account for the difference in her results and those presented here.

<sup>20</sup> For example, there is the issue of how prospective social insurance benefits, or more broadly the full range of public services, should be treated. But this topic has barely been opened up. We owe this point to Robert J. Lampman.

TABLE 5—MEDIAN INCOME AND MEDIAN NET WORTH OF FAMILIES WITH INCOMES OF LESS THAN \$3,000 PER YEAR AND OF MORE THAN \$10,000 PER YEAR, BY AGE OF FAMILY HEAD, 1962

Age of Family Head	Less Than \$3,000 Per Year		
	Median Net Worth (NW)	Median Income (Y)	Ratio NW/Y
Under 35	\$ 0	\$ 1,782	0
35-54	385	1,760	.22
55-64	5,625	1,646	3.42
65 and over	6,667	1,844	3.62
All	\$ 2,250	\$ 1,788	1.26
Age of Family Head	More Than \$10,000 Per Year		
	Median Net Worth	Median Income	Ratio NW/Y
Under 35	\$ 7,634	\$12,969	.59
35-54	20,349	13,449	1.51
55-64	35,524	12,420	2.86
65 and over	45,800	14,084	3.25
All	\$21,714	\$13,454	1.61

Source: Same as Table 3.

mains as to what level of income-net worth should be regarded as a poverty line for purposes of measurement or eligibility for public programs.

It seems reasonable that the "official" measures of poverty adopted by the U.S. Office of Economic Opportunity, which consider current income and family size, could be extended to encompass net worth as well. Indeed, something very similar to this has already been implemented by the College Scholarship Service which, in determining the eligibility of college students for financial aid—from both private and public sources—relies upon family net-worth data in addition to current income and family size. The 1966 Survey of Economic Opportunity (SEO) makes this approach applicable to a more general class of decisions regarding "poor" or "needy" people, for it will provide extensive data on the net worth of low income families by family size.

Turning briefly from the poor to the "affluent," we see in the bottom panel of Table 5 what effect consideration of the annuity value of net worth has on the upper end of the distribution of economic position. Considering money income only, 18 per cent of U.S. families, or 8.3 million families, were over the \$10,000 mark; but this rises to 27 per cent—12.5 million families—when net worth is annuitized at a 10 per

cent rate of interest. And, as with the low end of the distribution, the effect of considering net worth is markedly age-specific.

*Implications for defining tax progressivity and regressivity.* The income-net worth measure may be viewed as an alternative standard for viewing whether a given tax is "really" regressive, progressive, or proportional. We suggest that the ratio of taxes paid to current income may be a less useful standard for assessing vertical tax equity than is the ratio of taxes paid to income-net worth.

When net worth is considered in addition to income—in the manner we propose—the progressivity or regressivity of the tax system with respect to particular groupings of people will change in a systematic way. The essential reason for this is, as discussed above, that the ratio of income to income-net worth is not the same, either among income classes within age groups, or among age groups. Within any age group the use of the income-net worth base will show any tax, or the tax system as a whole, to be less progressive or more regressive, as the case may be, than if the conventional income base is used. This results from the fact that the ratio of net worth to income rises with respect to income. Similarly, the use of the income-net worth base will show any given tax to fall less heavily upon aged people than upon younger people. This results from the rising ratio of net worth to income with respect to age, and from the decline of life expectancy with respect to age. Both of these factors are captured in the proposed income-net worth measure but not in the current income base.

These illustrations can be generalized as follows. The net effect of the (1) rising ratio of net worth to income over the life cycle, (2) decreasing life expectancy over the life cycle, and (3) rise and then decline of income over the life cycle, will determine the precise dimensions of shifts in progressivity or regressivity by the income-net worth measure relative to that indicated by the use of current income alone. It is clear, however, that the picture of how our tax burdens are related to "ability to pay" is very different when our more comprehensive measure of "ability" is used. This suggests the desirability of undertaking studies of effective tax rates based not on current income but on ability-to-pay—as measured by income-net worth—for various taxes and for the tax system as a whole.<sup>21</sup>

*Consumption behavior estimation.* The approach presented in this paper for measuring economic position may be applied fruitfully to the prediction of consumer behavior. Indeed, *any* measure of economic position would seem to imply a theory of behavior, and vice versa. Thus, if economic position can be viewed as a function of annuitized net worth as

<sup>21</sup> The relevance of net assets to the "regressivity" of the sales tax has been discussed by Harold M. Somers in a statement prepared for the Joint Economic Committee [13].



well as current income, then we might expect consumer expenditure levels also to depend on these factors.

Consider, for example, the relationship between the level of consumer expenditures in a given time period, and the level of permanent income, or alternatively, the level of windfall income in that period. Employing our income-net worth approach we suggest that the MPC out of permanent income should be higher, in general, than the MPC out of windfall income—and that the difference should narrow with age.

The reasoning is as follows: an increment of windfall income may be viewed as, in effect, a lump sum transfer of net worth (simply assets in this case). As such, its effect on current consumption expenditures would tend to be determined not by the size of the capital transfer but by its annual lifetime annuity value. Given the size of the capital transfer and the interest rate, the annuity value will depend on the life expectancy of the recipient, and, hence, will vary directly with the recipient's age. In all but the limiting case in which life expectancy does not extend beyond the current period, the annuity value will be less than the capital value. Thus, even if the recipient's MPC with respect to *annuity* income were unity, the observed MPC with respect to the *capital* value would be less than unity, and would be smaller the younger is the recipient.

It is interesting to note that this testable prediction is similar to that arrived at by Modigliani-Brumberg-Ando [8], [1]. While they started with the objective of predicting consumption behavior, their work implies a measure of economic position—namely, that economic position at a point in time is the sum of net worth plus the present value of expected income, divided by the length of expected life. We on the other hand started with the objective of measuring economic position, but some of the implications of the measure for consumption patterns became apparent as our work progressed. It is to be hoped that in the future closer rapport will develop between researchers concerned with measures of economic welfare and those concerned with the theory of economic behavior.

### III. *Conclusions*

The income-net worth measure proposed here, while incomplete as a measure of economic welfare and imperfectly measured in this paper, has a number of useful attributes, the major one being that of merging two disparate but obviously related measures of economic position into a unified measure. The most striking result is its impact on the economic position of the aged, who by this measure appear to be considerably "better off" than is shown by the current income measure. This results from the interaction of income, net worth holdings, and life expectancy. In addition to questions about the distribution of economic position, the income-net worth measure may be useful as a basis for redefining tax

progressivity and regressivity, and as an explanatory variable in consumption behavior studies. Finally, it seems apparent that the measurement of economic welfare and the prediction of economic behavior are really two sides of the same coin, and that more explicit recognition of this fact would enrich the work in both areas.

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LÉON WALRAS' CORRESPONDENCE  
AND RELATED PAPERS:  
THE BIRTH OF MATHEMATICAL ECONOMICS  
*A Review Article*<sup>1</sup>

By SERGE-CHRISTOPHE KOLM\*

Léon Walras' *Correspondence and Related Papers*, edited by W. Jaffé, is the source book on the birth of mathematical economics. As Walras said, "Cournot and Gossen died unknown; Jevons died unsung."<sup>2</sup> He himself was first to succeed in breaching the wall of the scornful opposition to the application of mathematics to economics, only at the high cost of forty years of a much-resented exile and of endless struggles with this correspondence as a weapon. Jevons is here, and so is the old Cournot who had been the schoolmate of August Walras (Léon's father and mentor in economics) at the Ecole Normale Supérieure. Then come the Young Turks, scattered in the Western world, Walras' enthusiastic and grateful, or caustic and reluctant, disciples, brilliant and better mathematicians than the Master, arguing fine points and reporting news of the crusade for mathematical economics: Bortkiewicz ("my young slavic disciple"), Wicksteed, Edgeworth, Pareto, Barone, Wicksell, Fisher. And while mathematicians supply their inputs in scanty but remarkable letters, while all economists whose names are remembered express their enthusiasm, doubts, arguments or claims to priority, Walras tries to gain acceptance for his ideas through hundreds of letters to writers, scientists, publishers, government engineers, philosophers, officials, and friends. The hostility he encounters from the establishments of French lawyer-economists, German "historical" economists, British xenophobic circles, and Italian officials who forced Pareto, Pantaleoni and nearly Barone into exile,<sup>3</sup> deepens his bitterness.

\* The author is associate professor of economics at Stanford University. He is very grateful to the following persons who helped to make very substantial improvements in the presentation of these ideas: Paul Hohenberg, Paul Samuelson, William Jaffé, Kenneth Arrow, and the editorial staff of the *American Economic Review*. Full responsibility for remaining defects is assumed by the author.

<sup>1</sup> William Jaffé, editor, *Correspondence of Léon Walras and Related Papers*, Amsterdam: North-Holland Publishing Co., 1965. Three volumes. Pp. xliii, 799; xxvii, 763; xxiii, 538. \$40 for set.

<sup>2</sup> Previous applications of mathematics to economics, although sometimes marked by a touch of genius, were too casual to be really credited with much more than forerunners' insights. Walras was at least partially aware of the long series of studies extending over a century from Giovanni Ceva's 1711 paper to Von Thünen's 1828 book and having reached its high point with some physiocrats, in particular Isnard. We learn here that Pierre Samuel Du Pont de Nemours discussed his "political curves" with "the great Daniel Bernoulli"; however, the latter's study on maximization of expected utility (presented in Saint-Petersburg in 1738) could not possibly have been written for a "general price theory" "at the instigation of" the former (born 1739) as Walras was told by Oncken (letters 1251, 1252; I. will designate letters henceforth).

<sup>3</sup> Pareto was forbidden to give *free* lectures and went to Lausanne. Pantaleoni taught in

Toward the end of his life, a ray of hope comes from America where scholars are ready to accept the new idea, "if we explain them simply" cautions Barone.<sup>4</sup>

This *correspondence* is interesting on several grounds.

The main one may be that the reader witnesses, not without emotion, a whole era coming back to life. These letters are an extraordinary vivid and sensitive chronicle of French and Western intellectual social life at the turn of the century, with all the flavor it can have when filtered through the resentful mind of a typical Third Republic Radical-Socialist:<sup>5</sup> a contrasted mixture of deeply concerned, bitter, and indignant irony for the present and of humanitarian optimism for the future.

The second reason for the interest of this correspondence is its exceptional contribution to epistemology: it provides a uniquely detailed account of the psychology and sociology of the making of a science at the mathematization stage.<sup>6</sup>

We learn quite completely what were the motivation and the mathematical knowledge of one of the main scientists responsible for this intellectual mutation. We observe society's every reaction against a new idea which hurts established thought and scholars. We witness the long, anguished, and most of the time rebuked quest for social acceptance. All this is of special interest since it is the first revolution of this kind in the social sciences; the novelty relative to other fields lies not so much in new methods of knowledge as in a special social involvement of the science

Geneva. Major (later Colonel) Barone, while teaching strategy, desperately sought an appointment to teach economics and was ready to go "as far as America" for this before he finally found it at the Rome Business School (I. 1120, 1124).

<sup>4</sup> Rather than "simply," Barone uses the kindly protective nuance of "*bien simplement*" (I. 1224). The *Correspondence* shows a unanimously warm welcome to Walras' ideas from the United States. The main center of reception was Columbia where Henry L. Moore, who made the Lausanne pilgrimage to meet Walras, taught mathematical economics as early as in the first years of the century, and where E. A. R. Seligman, A. S. Johnson and J. B. Clark, although not mathematical economists themselves, read, appreciated, and probably understood Walras. More original, Irving Fisher at Yale also seems to have been much more isolated. Chicago is represented in this *Correspondence* by J. L. Laughlin.

<sup>5</sup> "Beautiful as '89," Walras writes to his friend Jules Ferry (the statesman who taught the French how to read). Walras resembled much at times an intelligent Monsieur Homais. His famous "Prayer of a Free-Thinker" is a model of its kind, though with none of the sparkle of Diderot's Testament ("Prayer to God, if He exists"). Quite matter-of-factly, Walras writes to a correspondent, "I am not a believer since I am a philosopher." One can only regret, for his image, that such a naturally Dreyfusard social writer did not involve himself more in the Affair. Walras also shares the special kind of chauvinism for "the country of the Declaration of the Rights of Man" characteristic of this Republican anti-Kaiser ideology: "Justice is a Greco-Latin and French idea," he writes to Adolphe Landry (there is something in it: the feeling became hazy in the northern fogs, and the same word is used for a definitely different idea, in the present American ideology, for instance).

<sup>6</sup> It is certainly not fortuitous that both Cournot and Jevons wrote huge volumes on gnosiology and epistemology, respectively.

which fosters specific, eager motivations and reactions; and Walras' viewpoint is very bound to this: for him the only justification and worthwhile outcome of mathematical economics is social reform.

Walras' letters tell us less about the immediate psychology of discovery than, for instance, Descartes' analysis of systematic mathematization in physics or Poincaré's account of mathematical intuitions. But they are probably more revealing than any other written piece on slow, long-term, recurrent discovery processes, since throughout his life Walras had only very few ideas (very important ones, though) which he kept pondering over for decades, improving upon them from letter to letter and from one edition of the *Eléments* to the next. Still more important, the *Correspondence* provides a fascinating example of the social process of discovery with feedbacks through colleagues engaged in similar endeavors. Such records are of special interest for those blessed periods in the history of a science when ideas have ripened to the point where several scientists discover the same things at the same time. This was certainly the case of economics around the 1870s when ten persons independently discovered marginal utility and its relation to relative prices, and around the 1880s when only a slightly smaller number of economists discovered the similar relation for marginal productivities.

A third matter of interest in these letters is the light they shed on the specific case of the development of mathematical economics. We shall expand on this point by considering first the problems of the economist Léon Walras himself, and then his arguments with the other mathematical economists.

## II

Léon Walras became an economist at the request of his father (even as a pledge to him);<sup>7</sup> the idea to treat the questions mathematically came to him by reading Cournot; but what was his knowledge of mathematics? How did he acquire the tools which were especially relevant to his own economic problems? What was the influence of scientific works in other fields on his discoveries and in particular on that of general economic equilibrium? The *Correspondence* is replete with information on these points.

Walras' mathematical skills were probably higher than Jevons', but certainly less than those of Bortkiewicz, Edgeworth, Pareto, Barone, Wicksell, and even Cournot. He acquired them in four ways. His studies in engineering gave him the start. At nineteen, he attended the special

<sup>7</sup> Finding engineering unsuited to his temper, Léon Walras first thought of entering on a literary career; and his first publication was a novel. Then at the age of twenty-four, he promised his father to devote his life to economics, and he went on writing a "refutation of Proudhon" (a traditional exercise among socialist economists of that time). At twenty-six he decided that his mission on earth was to build mathematical economics, and he started the thinking which he carried on till his death. But he had to wait until he was thirty-six (during the 1870 Prussian occupation of France) for the Lausanne "Academy" to offer him the opportunity to devote all his time to research and teaching, appointing him on the impression left by a lecture he had delivered ten years before (*Autobiography*, etc.).

classes designed to prepare candidates for the scientific "Grandes Ecoles," but he failed the entrance examination of the Ecole Polytechnique<sup>8</sup> because he spent his time reading Lagrange, Newton, and Descartes rather than the syllabus.<sup>9</sup> He then entered the second best school, Paris School of Mines, which he left after only one year obviously because of the meager social or philosophical content of geology. A second source of mathematical information came from his reading. In addition to the above mentioned authors, and while still preparing his "baccalaureat" of mathematics (hence, at eighteen) Walras read straight through Poinot's treatise on mechanics, which was to become the book of greatest influence on his later work.<sup>10</sup> Furthermore, all his life long Walras enjoyed mathematics and he at least looked into fairly advanced treatises. Thirdly, of the highest importance, because they were exactly to the point of his problems, were Walras' consultations with two of his Lausanne colleagues: the professor of mechanics and engineering Piccard<sup>11</sup> and the professor of mathematics Amstein; actually, these scholars must respectively be credited with "Walras'" discoveries of the relations between relative prices and marginal utilities, and between relative prices and marginal productivities, deriving them both from an explicit maximizing behavior assumption. Finally, Walras received a few extraordinary letters from mathematicians, engineers, actuaries, and statisticians (Perozzo, Poincaré, Laurent, and also D'Ocagne), giving straightforwardly the solutions of the basic problems at the heart of utility theory, and which he probably failed to understand thoroughly.

Let us try to trace out the origin of the ideas most important for economic theory.

*General equilibrium.* The *Correspondence* probably confirms general equilibrium as Walras' greatest and most original contribution. The inspiration definitely came from the general (static or dynamic) equilibrium of physical systems as studied in astronomy, for instance by Newton and Laplace whom Walras often mentions, and in mechanics. Poinot's treatise "Elements of Statics," with its Chapter 2 "On Equilibrium Conditions expressed by Equations" and its appendix on the "General Theory of Equilibrium and Movement of Systems," was crucially influential.<sup>12</sup> There Walras learned to deduce the conditions for general equilibrium from a general rule for the conditions of individual equilibria, and to determine the unknowns by a system of an equal number of simultaneous equations obtained by joining equilibrium and constraints equations.

*Relation between marginal utilities and relative prices, as derived from maximization of utility.* Paul Piccard, who helped Walras on many points, prepared a note for him in 1872, in which the equality of the ratio of the marginal utilities of two goods to their relative price is deduced from a

<sup>8</sup> This is not the worst scandal; Galois, too, failed, on mathematical examinations.

<sup>9</sup> Explanation given by the *Autobiography*.

<sup>10</sup> L. 1483, note 7.

<sup>11</sup> An uncle of the stratosphere and bathysphere Belgian twins.

<sup>12</sup> L. 1483, note 7.

description of the behavior of a person which is the maximization of a magnitude (the rationale is that this agent seeks "to satisfy as much need as possible").<sup>13</sup> This "utility" is the sum of the two "surpluses" under the marginal utility curves, each as a function of the quantity of the corresponding good.<sup>14</sup>

*Choice of technique and relation between marginal productivities and relative prices.* In 1876 or 1877, Walras asked Herman Amstein the outcome of the minimization of the unit cost of a product when the technical coefficients (which Walras calls "*coefficients de fabrication*") are linked by a production function.<sup>15</sup> It seems that Walras had implicitly in mind a production function in the quantities which would be homogeneous of degree one, rather than the equation of an isoquant of any production function written as a function of the inputs per unit of output thanks to the fact that the quantity of the latter is given. Amstein showed Walras the solution and methods of a constrained maximization problem and especially the use of a Lagrange multiplier (without using the name). However, twenty years later Walras scribbled a note in which he derived the equilibrium relations between relative prices and marginal productivities from a zero profit condition taken as an identity, with an explicitly given quantity of output. Only after 1900 did Walras pick up Amstein's suggestion and use a Lagrange multiplier to derive the relations from the problem he initially posed, this time explicitly with a given quantity of output.

*Ordinality of utility.* Henri Poincaré's letter to Walras<sup>16</sup> is the Magna Carta of ordinalism: never have the reasons and justifications, and also the obligations, of the use of ordinal utility been expressed so relevantly and in so few words. In addition, that all that he wanted was an ordinal utility function was clearly explained to Walras by the actuary Hermann Laurent<sup>17</sup> and by Pasquale Boninsegni<sup>18</sup> (Pareto's successor in Walras' Chair) in relation to the problems of "integrability," "measurability of utility," and "marginal utility of money." Walras shows that he understood these points. One then wonders why he so consistently used separable (additive) utility functions which keep this form under only a linear transformation and not an arbitrary increasing one. Did he believe that, as a psychological fact, one "cardinal specification" of the ordinal utility is separable (that is, an ordinal version of Pigou's views)? More likely he did not think this question through thoroughly (and neither did Pareto after him, in spite of his good formulation of the subject, as is proven, among other things, by his definition of complementary and substitutable commodities).

*Integrability conditions.* This is precisely why Walras failed to under-

<sup>13</sup> pp. 308 to 311.

<sup>14</sup> It is unfortunate that the labels of the axes in the diagrams on page 309 are wrong: they are inverted (the marginal utilities should be on the *abscissa*), and they are not even in the notation of the text.

<sup>15</sup> l. 364, and note pp. 517 to 520.

<sup>16</sup> l. 1496.

<sup>17</sup> cf. l. 1452, 1454, 1455, 1456.

<sup>18</sup> l. 1706.

stand Luigi Perozzo's suggestion on integrability conditions, since these are trivial with his additive utility. Perozzo was an Italian official statistician who worked up some price statistics for Walras' ideas on money and discussed at length the latter's plan for international liquidity. In a February 1890 letter<sup>19</sup> he generalizes the idea elaborated by G. B. Antonelli in his remarkable 1886 *Sulla teoria matematica della economia politica*,<sup>20</sup> that demand functions are a Jacobian system (i.e., are integrable into a utility function): considering that the observed, or theoretically justified, joint variations of prices and quantities, or only prices, can yield relations between these magnitudes which are not demand functions (i.e., quantities as function of prices and income or—as in Antonelli's study—of prices and initial endowment of commodities), he writes from Jacobi's theorem the integrability conditions for sets of such relations which are much more general than demand functions.<sup>21</sup> Then Perozzo suggests that in order to have the same success as the physical sciences, economics must seek a "fundamental partial differential equation" which would play the role that such an equation holds in most fields of physics or mechanics. He goes on to construct it along the lines of heat theory.<sup>22</sup> "Then," he says, "we enter into the theories of potential which I believe to be applicable in all their parts to economics with concepts which I shall mention to you another time since I do not want to exhaust your kindness with a longer letter." This was a Fermat-like statement since Walras' lack of enthusiasm for these ideas discouraged Perozzo from keeping his promise.<sup>23</sup>

*Duality.* Since his mind was not turned toward the "contact elements" of indifference loci, it is not surprising that Walras did not exploit the duality ideas which were presented to him on at least two occasions. The

<sup>19</sup> I. 962.

<sup>20</sup> Reproduced in 1952 by Malfasi Editore, Milano.

<sup>21</sup> After that, it only remains to take into account the possibility of ridges in the indifference surfaces (discontinuities of the gradient of utility). This offers no difficulty since the whole problem is "Pfaff's simple problem," the solution of which has been completed by Goursat.

<sup>22</sup> I understand his basic reasoning as the following. If the arguments of a production or utility function are subject to small changes due to a great number of independent causes in each differential time interval, this gives a term of the time derivative of the function which is the sum of the second order partials with respect to each of the variables, weighted by the marginal variance per unit of time of the corresponding variable (only the fact that these variances can be different makes this sum different from a term proportional to the Laplacian). More generally, many ideas of statistical thermodynamics and statistical mechanics could be applied to a "statistical economics," and to start with "statistical aggregation" which computes the probabilities of macro variables or relations by counting the number of micro system states which present a given macro property. Cournot was certainly at some point not far from these ideas when he classified social sciences as "combinatorial sciences" (as opposed to what he called the "quantitative" ones).

<sup>23</sup> Walras' answer to this letter (I. 969) does not show the "Maitre de Lausanne" at his very best. He basically says that (1) although he read the letter several times, he does not understand the formulas; (2) it so happens that economists who were mediocre mathematicians, such as Jevons, produced good theories, whereas mathematicians who were not economists enough, such as Edgeworth, Auspitz and Lieben, wrote much nonsense; (3) but Perozzo will be safe if the publication of his researches is preceded by a summary of the *Éléments* theory "which would be as useful for the reader as for yourself." This sentence ends the long correspondence between the two men.



first was his friend Amstein's book on tangential coordinates which he looked at closely and discussed, but apparently did not relate to his own problems.<sup>24</sup> The second was Edgeworth's use of a dual utility function, i.e., of utility as a function of prices and income (a "Hotelling-Roy" form); this formulation, made in 1891, and hence, to my knowledge, for the first time in history, was certainly seen by Walras since it was in a note discussed in Bortkiewicz's defense against Edgeworth's attacks on "the Helvetian Jevons."<sup>25</sup>

*Application of mathematics.* Developing a new field of application of mathematics, Walras was much inspired by, and ceaselessly refers to, the use of mathematics in other sciences. Reading Descartes, he could not fail to have been influenced by his physics, epistemology, and still more directly his mechanistic behavioral theory of machine-animals. Astronomy is often referred to, and I believe that the deep reason for it is not so much the general equilibrium flavor of this science or its use of a basic unitary law (gravitation), but the striking fact that the first natural science to develop was nonexperimental, as is the first social science.<sup>26</sup> But throughout the correspondence the main source of comparisons is mechanics, leading to the famous peroration of Poincaré's letter: "In mechanics, we often neglect friction and consider bodies as being infinitely polished. You look at men as if they were infinitely selfish and infinitely foreseeing. The first hypothesis can be admitted as a first approximation, but the second one might require some reservations."

### III

Of paramount importance for the history of economics are the reports in the *Correspondence* of Walras' technical discussions with other mathematical economists (including those who regarded mathematics as useful for research but not for exposition: Carl Menger, Marshall, and Boehm-Bawerk). We witness the variety of reactions of Walras, Jevons, and Menger when they discover that the others have also had the idea of marginal utility and its relation to prices and that Gossen anticipated them all; we hear Marshall's claims to the discovery and learn that two Dutchmen probably also had this idea independently. We watch the rounds of the nervous polemics between Walras and Edgeworth on capital theory and amortization ("you are at the door of understanding capital theory," Walras urges encouragingly).<sup>27</sup> We appreciate Wicksteed's and, much

<sup>24</sup> I. 396 and I. 397 with the mathematician Haton de la Goupillière.

<sup>25</sup> I. 998, note 5 of p. 433.

<sup>26</sup> This science also provided Walras with most of his examples of great discoverers who were misunderstood. He liked to recall Laplace's assertion that there is a lag of fifty years between a fundamental discovery and its social acceptance, and he was certainly deeply touched, during his Jubilee, to hear the feature speaker's quotation of Kepler: "God waited six thousand years before a man understood him, I can wait a century before men understand me."

<sup>27</sup> The misunderstanding between the two men basically stemmed from Edgeworth's excessive cleverness which made him give Debreu(-Fisher-Arrow)-like solutions in the style: "just redefine the variables (date, insure or localize them, for instance) and it is all the same thing again." This shocked Walras who was used to verifying carefully that each argument apply to each new question, even at the cost of tedious repetition.

better, Barone's clearing up of the constant return to scale question. We take interest in the discussion with Pareto on the constancy of technical coefficients. We read the correspondence with Wicksell on "liquidity preference" and the sensitivity of the demand for money to the rate of interest, on Walras' "approximative quantity theory," and on the inventory theory of the demand for money (not with an explicit inventory model, though; we had to await Allais' *Economie et Intérêt* for this).<sup>28</sup>

A recurrent reproach from Walras to other authors is their "confusion between demand and utility curves." He means marginal utility, and with his additively separable utility this is equivalent to an accusation of assuming "constancy of the marginal utility of money or income" (the "final degree of instrumental utility," as Barone interestingly calls it).<sup>29</sup> Dupuit, Marshall, and Auspitz and Lieben repeatedly incur this reproach. As applied to Dupuit, this is a case of misunderstanding by Walras (also stated in the *Eléments*) for the following reason. The demand curve for a commodity generally comes from several demanders consuming several units each; Walras even bases his criticism on only one demander consuming several units; but Dupuit's demand curve is that of many demanders each consuming one unit: each person crosses his bridge once only and therefore does not provide an "income effect." This remark shows us what really is Dupuit's optimality formula on "the utility of *public* works." The rule reads: provide as long as the "surplus" exceeds the cost. Hence, for a marginal construction the "surplus" equals the cost. But this surplus is the sum of the agents' willingness to pay for this marginal product. Therefore, Dupuit's criterion is the Bowen-Samuelson optimality formula for "public goods."

Conspicuously lacking from the *Correspondence* are the topics on which Walras was much in advance of his contemporaries (the pure theory of money is only little discussed, the *tâtonnement* or groping is just mentioned), and those that are logically the next stages of his line of thought but which he failed to reach. The most striking of the latter omissions, which is closely linked to Walras' failure to understand Dupuit, is the coping-stone of Welfare Economics: interpersonal comparison of utilities. It was of course his successor Pareto who was destined to solve this problem, with his 1913 invention of both the social welfare function and normative interdependence of utilities.<sup>30</sup>

<sup>28</sup> *Economie et Intérêt*, pp. 238-41.

<sup>29</sup> I. 1188.

<sup>30</sup> V. Pareto: "*Il massimo di utilità per una collettività in sociologia*," *Giornale degli Economisti*, April 1913, pp. 337-40. This paper is reprinted as a long footnote in Chapter 12 of Pareto's *Treatise of Sociology* and hence translated into English with the latter ("*Mind and Society*" for the first editions). Roughly, Pareto's ideas are the following. Each person has both an ophelimity which is a function of the quantities of commodities he consumes, and a utility which is a function of everybody's ophelimities. Then there is a government's social welfare function which is a function of everybody's utilities. A lack of "respect of people's preferences" at the utility stage (not the ophelimity one, i.e., on ophelimities and not on commodities) is considered. All this is written in differential form. This "normative interdependence" is of course

Walras spent most of his letter paper and energy on his three crusades, treating them on the same footing, with equal emphasis and attention, as if they were truths of the same kind, scientifically proven and unquestionable, and with the same great conviction for each that it would save mankind: (1) mathematics must be used in economics, (2) land must be nationalized, (3) international liquidity must be provided by "gold money with regulatory silver token currency." The last is an ingenious scheme to shield economies from deflations or inflations due to variations in the world stock of gold by compensatory monetization or demonetization of silver coins; it stems, of course, from Walras' solution of the "Anglo-Indian currency problem." The land question is based on Walras' belief that in a progressive society land rent must ever increase, and "the buying back of lands by the State," which the capitalization equation proves to be possible, is his definitive and almost only solution to the problems of finding public revenue, and hence of taxation, and of social justice.<sup>31</sup> Walras had the genius of grandiose simplification; he owed his scientific discoveries to it; but he did not apply it less to policy recommendations.

#### IV

For all his advertising and proselytism, Walras never sought personal fame: he wanted his ideas to be accepted only because he thought them true and useful, or even necessary, for society's welfare. In this he is similar to Cournot whose life-long quest for social recognition was no less intense in persistence and dedication. The two men fraternize in their mathematical and anti-*laissez-faire* faith,<sup>32</sup> although Walras elsewhere<sup>33</sup> criticizes Cournot for having indulged in a translation of his Wealth Theory from mathematics into literature, which seemed to him somewhat of a betrayal. But there was between the two men a difference which might be held responsible for the fact that Cournot failed and Walras finally succeeded in making a social breakthrough: although they shared the same credo both in method and on basic points in political conclusion, Walras believed much more than Cournot that the latter was a necessary consequence of the former. Mathematics plus a self-styled socialism was Walras' explosive mixture that could not fail to draw attention. Cournot kept the ingredients apart, and his marvelous pleas for precise reasoning in economics offer a merely scientific, hence much less conspicuous, lure. Cournot wanted justice for truth, Walras wanted truth for justice.

Walras' boldness and Cournot's prudence are the more surprising as the latter started from monopoly (nondiscriminating, contrary to Dupuit's)

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a different idea from the dependence of someone's utility upon other people's consumption which had been described by Cunyngghame in 1892 and by Pigou in 1903 (both in *The Economic Journal*).

<sup>31</sup> Hence, one can say in some sense that Walras was both Henry George and Alfred Marshall in one man: what a success would have been his, had he addressed English-speaking audiences.

<sup>32</sup> I. 231, 253.

<sup>33</sup> See Walras' comments edited with the *Recherches sur les principes mathématiques de la théorie des richesses*.

which is the best suited to show the social mischiefs of private enterprise whereas the former started from what he believed to be on the opposite "the general case," perfect competition, which is the traditional heavy artillery of *laissez-faire* panegyrists. Cournot expressed fears that Walras' approach would drive him into the latter school (thereby revealing a not so scientific core of prejudice and distrust in models). But Walras reassured him.<sup>34</sup> Although he enjoyed making due fun of the misunderstanding with which his ideas were received by many circles of "literary" economists who believed that mathematical economics was intended to be a substitute for the market mechanism, he never doubted that the advocacy of State intervention was the direct, logical, outcome of his whole model. And he was shocked that Pareto could deduce the opposite conclusion from the same set of equations.

Were reason of any importance in the social spreading of ideas, Walras' boldness would have done disservice to his cause. On the contrary, his impressive conviction helped call attention to his theories (if only to refute the argument, one would have to learn the equations of exchange which are asserted to prove it). Still more important, his total lack of doubt about the practical usefulness of his mathematical scribbles for the happiness of mankind induced him to carry out his propaganda with the energy, offensiveness, and perseverance of an apostolate: he knew his fight was both with the right tools and for the right cause. Such a fortunate position could not have been provided to him by a mere *laissez-faire* conclusion: to study competition at length just to conclude that the best is not to do anything about it would not have seemed worthwhile to such a highly socially motivated mind. His conviction also enabled him to stand disappointments, rebukes, and rejections. For all his bitterness, Léon Walras was a happy man: he enjoyed the serenity of prophets.

But "no man is a prophet in his own country," a comforting Seligman reminds him.<sup>35</sup> And Walras, who was forced into exile because he could

<sup>34</sup> Here is their dialogue.

—Walras (l. 230): "... we have proceeded in opposite directions. You start from monopoly to arrive at indefinite competition. I thought I had to start from indefinite competition, which I consider to be the general case, to arrive at monopoly, which seems to be a special case. This way is more difficult, but I believe it to be more beautiful and more complete."

—Cournot (l. 231): "... it is a question of method. Mine seems faster, yours goes at a slower pace, which suggests it goes at a surer pace. ... But I fear that your curves of 'intensive and extensive utility' will lead you to pure *laissez-faire*, that is to say, for the national economy to deforestation of land, and for the international economy to the overwhelming of plebeian races by a privileged race in conformity to Mr. Darwin's theory."

—Walras (l. 253): "... as for the consequences of 'pure *laissez-faire*,' you will see that I shall know how to avoid them. ..."

These letters also show Cournot presenting Walras' manuscript to the publishing house Hachette (founded by a schoolmate of Cournot and Auguste Walras), and warning Walras that, given the commercial success of his own books, his recommendations might not be the most convincing ones for a publisher.

<sup>35</sup> Seligman says more: "In France especially, it seems to be true that 'no man is a prophet in his own country,' but in the United States at least you may be assured of the fact that your views are carefully studied and therefore appreciated" (l. 1516).

not find an appointment to teach economics in France, devotes a great part of his correspondence to ironical or indignant criticism of French Law School economics which constitutes the official thought and has a legal monopoly of teaching in that country.<sup>36</sup> But it would be improper to expose these ideas of Walras here, since every single word of them is still valid today. Contrary to an American belief, "*plus ça change, plus c'est la même chose*" has never been a French proverb; but it is very much a French fact.<sup>37</sup>

## V

The "Related Papers" added to the *Correspondence* provide the reader with many a delight. Two of the best French poets wrote strikingly penetrating reviews of Walras' *Eléments*: Paul Valéry, brilliant as ever, hitting right to the heart of the logic of mathematization in economics, and Charles Péguy, then still a student at the Ecole Normale Supérieure, in a hurry to see the social justice implications of mathematical economists' writings (the title of his review is "A Socialist Economist: Léon Walras"); their argument cannot be summarized (Péguy's is already condensed) since, as Valéry says here of good mathematics books, "the ratio of their form to their content is constant." Let us mention also the interesting comparisons between economics and mechanics and potential theory presented by the famous mathematician Charles Emile Picard at the 1904 Saint-Louis World Fair. And in the year of the creation of the Nobel Economics Prize, it is ironical to witness the repeated failures of the man who would have probably deserved, and certainly needed it the most in his candidacies to the Nobel Peace Prize; Walras' claim for it was, of course, his theoretical work; but, he remarks, "never did the Committee seem to understand that one could serve the cause of Peace in this manner and otherwise than by efforts such as political demonstrations, peregrinations, congresses, etc."<sup>38</sup> (Actually the first Nobel Peace Prize was awarded to an economist, Frederic Passy.)

<sup>36</sup> As an exception, Charles Gide was Walras' friend. There are many letters between the two men. They do not appear in this review only because there is not a single interesting idea in them. Gide is of course well known as a historian of economic thought. In fact, this makes the difference between the two men strikingly revealing the basic disease of French official and Law School economics. Gide presented others' ideas, Walras had ideas: the former was the great man of the Paris Law School, the latter was exiled. Then as now, a conception of economics centered on the history of thought (or worse, "doctrines") prevents these scholars from having their own, and hence precludes their attaining a genuine understanding of the creators; therefore it is not even the history of good thought: when presenting his friend Walras' ideas, Gide only retains nationalization of land. All this, many people know, feel, whisper, but do not shout, leaving the sound to the other side; let them be asked: when the stake is society's view of economics, and, much more important, the education of thousands of students, when this usurpation happens in a country which has contributed so much and has so much to contribute to world's culture and science, then, must one be polite or must one be sincere?

<sup>37</sup> Hence, when using this expression, one should say not "as the French say," but "as the French do."

<sup>38</sup> *Notice Autobiographique*, p. 13. When in 1907 Theodore Roosevelt won the prize, Walras wrote to a friend "Roosevelt m'a soufflé le Nobel" (I. 1649).

We must end with a word about William Jaffé's editing work. It strikes the reader at first sight as being monumental: over two thousand large pages (in three volumes), more than thirty years of labor, in four languages.<sup>39</sup> But it is no less impressive after the perusal of the book: the very numerous notes make for easy reference and give an account of the identity of every person mentioned and of the content of the articles, reviews, lectures, documents, etc., referred to. Unfortunately, the fact that most of the letters are in French whereas the notes are in English makes the full work available to the intersection, rather than the union, of the sets of English- and French-speaking economists. But this work is definitely the child of the International of economists: a Dutch publisher, an American editor with Belgian help, for a French economist living in Switzerland and corresponding with the whole Western world, from Saint-Petersburg to Chicago, from Stockholm to Naples. Finally, through Walras' character, the panorama of his time, and the making of his science, the editor's personality appears as a watermark: it is that of a man of high culture.

<sup>39</sup> In fact five: French, English, Italian, German, and Alfred Marshall's French which is a language in itself (rather Romance, in spite of everything).

# COMMUNICATIONS

## Allocating Joint Costs

Most economists who mention allocating joint costs maintain that it cannot be done in any rational way.<sup>1</sup> I suggest that management scientists ought not to be led astray by the economists' traditional arguments on allocating joint costs and that meaningful answers to reasonable questions can be provided. I also suggest that joint costs can be "allocated" to facilitate rational decision-making.

Joint cost allocations are marginal revenues and are determined in part by conditions of demand. The purist may be content with the label *marginal revenues*, but he should be aware that answers to businessmen's and accountants' pertinent questions are available and that subsequent decisions based on these answers will be correct by maximizing criteria. The textbook point, with which there can be no disagreement, is that rational production and sales decisions must be independent of the cost allocation. I show the manager who wants an opportunity cost or the accountant who wants a cost for inventory evaluation how to determine these numbers but I wish to emphasize that calling the numbers "costs" does not change the fact that they are marginal revenues.

The classic example, which will suffice here, is the allocation of the cost of cattle for beef and hide production. Let a unit of beef be the amount of beef obtained from one cow; similarly define a unit of hides.  $Q_b$ ,  $P_b$ ,  $Q_h$ , and  $P_h$  represent the quantity and price of beef and hides. One cow costs \$10. Let the demand curve for beef be

$$(1) \quad P_b = 30 - 2Q_b$$

and that for hides be

$$(2) \quad P_h = 20 - Q_h$$

A traditional arithmetic analysis of this example provides the profit-maximizing plan: buy 6-2/3 cows, sell 6-2/3 units of beef at unit price of \$16-2/3 and sell 6-2/3 units of hides at unit price of \$13-1/3.<sup>2</sup> Traditional economic analysis would not allocate the \$10 per cow to hides and beef.

<sup>1</sup> See, for example, [1, pp. 239-41] or [4, p. 165]. The approach used in this article is similar in many ways to that in [3].

<sup>2</sup> The traditional economist might solve the problem of optimal production given any number of joint products using these steps: (1) Derive total revenue ( $TR$ ) and marginal revenue ( $MR$ ) functions for each of the joint products; (2) Add these together to derive a joint  $TR$  for all of the products produced from the common resource; (3) Assume that the profit maximizing action is to sell equal quantities of all the joint products; (4) Derive a joint  $MR$  function by differentiating the joint  $TR$  function with respect to the quantity assumed to be the same for all products; (5) Set  $MR$  equal to marginal cost (the cost of one unit of the common resource) to solve for a quantity,  $Q^*$ ; (6) Evaluate  $MR$  for each of the individual products using the quantity found at step 5; (7) If all these marginal revenues are nonnegative then the optimal solution is to buy  $Q^*$  of the resource and sell  $Q^*$  of each of the joint products; (8a) If  $MR$  found at step 6 is negative, set the  $MR$  function for that commodity to zero to solve for the optimal

Such an allocation must be arbitrary, for there is no one basis of allocation that is more persuasive than others. Indeed *any* allocation of common costs to one product is irrational if it affects the amount of the product produced, for the firm should produce the product if its price is at least equal to its minimum marginal cost. [4, p. 165.]

Suppose, however, that an outside supplier comes to this cattle buyer and offers individual units of beef *or* hides for sale. Up to what prices should the cattle buyer be willing to pay for an extra unit of beef? Of hides? Surely these are reasonable questions and traditional analysis yields the answers, which are the marginal revenues for each of the products: up to \$3-1/3 for beef and \$6-2/3 for hides.

The *sum* of the maximum prices the cattle buyer should be willing to pay for extra beef and extra hides *will always be exactly equal to the price of one cow*. Now, I claim, these prices whose sum is the cost of one cow are proper allocations of joint cost. Cost allocation as dictated by the maximum alternative prices leads to rational decision-making. If nothing else, these costs reveal what outside suppliers can be paid and how an inventory can be valued. If the cattle buyer asks "what is the cost of beef (or hides) alone?" for whatever reason, there is a basis for a justifiable and persuasive answer.

#### *How to Find Persuasive Allocation*

The allocation is found using constrained optimization, Lagrange multipliers, and Kuhn-Tucker theory. We can formulate the beef-hide problem of the previous section as:

$$(3) \text{ maximize } P_b Q_b + P_h Q_h - 10C, \quad \text{subject to } Q_b \leq C \text{ and } Q_h \leq C$$

where  $C$  is the number of cattle bought. This is a simple optimization problem with two inequality constraints. The following, adopted from Teichroew [5, pp. 305ff.], is a brief review of how to solve well-behaved optimization problems subject to inequality constraints.

1. Determine the optimum by using Lagrange multipliers for each inequality, assuming each inequality holds as a strict equality.
2. If all the Lagrange multipliers are nonnegative, the optimum so obtained is also the optimum subject to the inequality constraint.
3. If any Lagrange multiplier is negative, re-solve the problem without regard to the particular constraint for which the associated Lagrange multiplier is negative. The resulting optimum will usually satisfy the disregarded constraints and will be the solution to the problem.<sup>3</sup>

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quantity of that joint product; (8b) Repeat steps 1 through 8 for all the products with non-negative  $MR$ .

For this example with linear demand and cost curves and only one joint resource, the solution could be derived from a simple diagram. The mathematics is introduced here so that the more complicated example below can be solved with the same technique as the simple example.

<sup>3</sup> The steps in the Kuhn-Tucker analysis are almost the same as those the traditional economist would use. If nothing else, Kuhn-Tucker methods provide a systematic computational procedure. Step 3 of the process can be more complicated than indicated here; see any reference on optimizing with multiple inequality constraints, e.g., [5].



Substituting from demand equations (1) and (2) into (3) yields

$$(4) \quad \text{maximize } (30 - 2Q_b)Q_b + (20 - Q_h)Q_h - 10C, \\ \text{subject to } Q_b \leq C \quad \text{and} \quad Q_h \leq C$$

and the associated Lagrangian (from step 1 above) is

$$(5) \quad \text{maximize } \prod (Q_b, Q_h, C, \lambda_1, \lambda_2) \\ = 30Q_b - 2Q_b^2 + 20Q_h - Q_h^2 - 10C - \lambda_1(Q_b - C) - \lambda_2(Q_h - C).$$

Finding the first partial derivatives of  $\pi$  with respect to its arguments and setting the derivatives to zero yields a system with solution  $Q_b = Q_h = C = 6.2/3$ ;  $\lambda_1 = 3.1/3$ ,  $\lambda_2 = 6.2/3$ . According to step 2 of the solution procedure, this solution must be optimal for the original problem because both Lagrange multipliers,  $\lambda_1$  and  $\lambda_2$ , are nonnegative.<sup>4</sup>

The Lagrange multipliers on the constraints requiring that only as much beef can be sold as cattle are bought and only as many hides can be sold as cattle are bought are the allocations of joint costs for beef-part-of-cow and hide-part-of-cow which we seek. Note the equation in the system derived from (5) corresponding to the partial derivative with respect to  $C$ :

$$(6) \quad \lambda_1 + \lambda_2 = 10.$$

The prices used to allocate the joint cost must sum to the cost of a cow. This must always be so, for any number of joint products and for any kind of demand equations. Equation (6) is not enough to determine  $\lambda_1$  and  $\lambda_2$ ; it only specifies what their sum must be. The conditions of demand will help to determine  $\lambda_1$  and  $\lambda_2$ .

The values of the Lagrange multipliers are the same numbers that the economist derives as marginal revenues. Lagrange multipliers are typically interpreted as opportunity or implicit costs or as shadow prices. This fact lends credence to calling them costs as well as marginal revenues in the joint cost problem.

The Kuhn-Tucker technique for allocating joint costs can solve even more complicated joint-cost problems where diagrams would not help—for example, when there are multiple joint resources and individual as well as joint production costs. Consider the following example adapted from a problem formulated and solved by H. Bierman [2]. One raw material  $R$  can be used to produce three goods  $A$ ,  $B$ , and  $C$ . To produce  $A$  requires  $R$  and a finishing process. To produce  $B$  or  $C$  requires a further processing of  $R$  and a different finishing process. The costs are,

One unit of raw material ( $R$ )	\$20
Cost of finishing $A$	7
(Joint) cost of processing $R$ to produce $B$ and $C$	10
Cost of finishing $B$	5
Cost of finishing $C$	3

<sup>4</sup> The other possibilities for the optimizing procedure can be seen if the problem is reformulated first with the constant in demand equation (1) equal to 15 rather than 30 and then equal to 50 rather than 30.

Let  $f(A)$ ,  $g(B)$ ,  $h(C)$  be the price functions for quantities  $A$ ,  $B$ , and  $C$  sold. Let  $R_1$  be the amount of raw material bought and let  $R_2$  be the amount of  $R_1$  processed for producing  $B$  and  $C$ . The problem is to

$$(7) \quad \text{maximize } Af(A) + Bg(B) + Ch(C) - 20R_1 - 10R_2 - 7A - 5B - 3C \\ \text{subject to } A \leq R_1, R_2 \leq R_1, B \leq R_2, \text{ and } C \leq R_2$$

for which the associated Lagrangian expression is

$$(8) \quad \text{maximize } \prod (A, B, C, R_1, R_2, \lambda_1, \lambda_2, \lambda_3, \lambda_4) = \\ Af(A) + Bg(B) + Ch(C) - 20R_1 - 10R_2 - 7A - 5B - 3C \\ - \lambda_1(A - R_1) - \lambda_2(R_2 - R_1) - \lambda_3(B - R_2) - \lambda_4(C - R_2).$$

Partial derivatives of  $\pi$  with respect to  $R_1$  and  $R_2$  set to zero yield

$$(9) \quad \prod_{R_1} = -20 + \lambda_1 + \lambda_2 = 0 \\ (10) \quad \prod_{R_2} = -10 - \lambda_2 + \lambda_3 + \lambda_4 = 0.$$

Equation (9) allocates  $\lambda_1$  of the \$20 cost of  $R$  to  $A$  and the remainder,  $\lambda_2$ , to  $B$  and  $C$ . The allocations to  $B$  and  $C$  must cover the  $\lambda_2$  left over after  $A$  has been taken into account plus the \$10 of further processing costs to produce  $B$  and  $C$ . Equation (10) allocates  $\lambda_3$  of the amount \$10 plus  $\lambda_2$  to  $B$  and the remainder,  $\lambda_4$  to  $C$ . These two equations alone are, of course, not sufficient to determine the  $\lambda$ s. The other eight equations of the system will be enough in addition. Thus the allocation is very much dependent upon the demand equations.

The variations and complications on this theme can be made ever more elaborate but the point is made. Kuhn-Tucker analysis allows us to easily identify marginal revenues and to use them for economic or accounting purposes where allocated joint costs are wanted.

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### The Pope and the Price of Fish

For over one thousand years, the Catholic Church required its members to abstain from meat on Friday in the spirit of penance [6, p. 847]. This obligatory abstinence from meat has helped maintain the sagging U.S. commercial fishing industry. However, Pope Paul VI in February of 1966 issued an apostolic decree, "Poenitemini," relaxing the rules on fasting and abstinence during Lent. As part of the decree, the Pope delegated power to national conferences of local Bishops to decide whether to continue the rule of Friday abstinence. Having this authority, the Catholic Bishops of the United States terminated obligatory meatless Fridays, except during Lent. Starting in December 1966, Catholics were no longer bound to abstain from meat eating on non-Lent Fridays (i.e., approximately 46 Fridays during the year).

The actions of Pope Paul VI and the U.S. Bishops have come in the wake of government efforts to arrest the decline in commercial fishing through the 1964 Fishing Fleet Improvement Act [1, pp. 141-62]. On a broader scale, the reaction of the world's 584 million Roman Catholics may seriously damage commercial fishing in many countries. The purpose of this article is to assess the short-run economic impact of the Papal-Bishop decree.<sup>1</sup> For New England, the test area, it will be demonstrated that during the nine-month period following the P-B decree the demand curve for fish has shifted downward resulting in a 12.5 per cent fall in landing prices.

#### I. The Demand Function for Fish

To evaluate the impact of the P-B decree on fish prices, all other factors which affect prices must be held constant. The following log-linear demand function for the  $i$ 'th species of fish was specified:

$$(1) \quad P = KQ^a Y^b S^c I^d C^e L^f Z^g (P - B)^h$$

where

$P$  = Ex-vessel or landing price in New England for the  $i$ 'th species (cents per pound)

$Q$  = Quantity landed of the  $i$ 'th species in New England (thousands of pounds)

$Y$  = Aggregate personal income in 1957-59 dollars for the Northeastern United States (tenths of millions)<sup>2</sup>

$S$  = Cold storage holdings of the  $i$ 'th species at the beginning of the month in New England (thousands of pounds)

<sup>1</sup> Since Pope Paul VI authorized the national Bishops to make the meatless Friday decree, we shall refer to the two decrees as the Papal-Bishop decree. The abbreviation P-B will be used throughout the remainder of this note.

<sup>2</sup> Northeast is defined as Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, Pennsylvania, and New Jersey. Most of the species landed in New England are marketed as fresh fish in the Northeast [2, pp. 7-8].

$I$  = Imports of the  $i$ 'th species into New England (thousands of pounds)

$C$  = Consumer price index for meat and poultry; 1957-59 = 100

$L$  = Lenten demand: 1 for non-Lenten months; 10 for Lenten months<sup>3</sup>

$Z$  = Weighted ex-vessel price for competing New England fish products landed (cents per pound)

$(P-B)$  = P-B decree: 1 for all months prior to the decree; 10 for all months in which decree is in effect.

A log-linear demand function was specified since a substantially better statistical fit was obtained through the use of a logarithmic as compared to a simple linear function and the unexplained residuals were more uniform over the range of independent variables when expressed in percentages rather than absolute terms. Most of the variables included in the demand function are self-explanatory. Of special importance, the quantity landed is functionally related to the movement of fish populations and the weather. There is little attempt by fishermen to influence landing prices by deliberate variation in quantity landed. In the short run, the supply function is completely inelastic and shifts in this function should "trace-out" the demand curve [13]. And, since we are using monthly observations, the period is approximately the short run. Therefore, no identification problem is present since quantity landed is exogenous. Cold storage holdings may have two different effects on price. The first is negative or stock adjustment of inventory effect. The second is positive since buyers may purchase when prices are falling (i.e., in the summer months) and sell (i.e., in the winter months) when prices are rising. This latter speculative behavior has been pointed out by Brennan [3].  $(P-B)$  should have a negative parameter if Catholics switch from fish to meat on Fridays. An estimate of " $h$ " will allow us to compute the percentage shift in the demand curve after the November 1966 P-B decree.

## II. Statistical Analysis and Results

The Northeast United States is an excellent area to analyze the impact of the P-B decree on the demand curve for fish. Large quantities of fresh fish are landed at many New England ports and are mainly distributed throughout the Northeast. In addition, the last Census of Religion revealed that 45.1 per cent of the population in the Northeast were Catholics, more than double the percentage in any other U. S. region [7, p. 6]. Seven species of fish were selected for this study (see Table 1). There are two time periods under consideration: (1) a 10-year period (monthly observations) before the P-B decree, January 1957 to November 1966<sup>4</sup> and (2) the period after the decree, December 1966 to August 1967, but excluding February and March.

<sup>3</sup> When 1 and 10 are converted to common logarithms, the dummy variable becomes 0 and 1 in the log-linear equation.

<sup>4</sup> The Lenten months for 1966 were excluded from the first period due to the possible influence of the Papal decree alone on these observations.

TABLE 1—REGRESSION RESULTS: A TEST OF THE PAPAL-BISHOP DEGREE IMPACT, MONTHLY DATA, 1957-67  
(Landing Price ( $P$ ) is Dependent Variable)

Species	Constant	Q	Y	S	I	C	L	Z	(P-B)	N	$\bar{R}_1$	D-W	Per Cent Change in Price Due to (P-B)
Sea Scallops	1.667 (1.540)	-.653 (-9.888)	.395 (1.874)	-.154 (-6.068)	.014 (.759)	.461 (1.700)	-.004 (-.217)	-.260 (-3.900)	-.082 (-3.019)	123	.696	.709	-17
Yellowtail Flounder	-5.678 (-4.766)	-.436 (-13.732)	.861 (3.090)	.182 (5.179)	-.054* (-1.097)	1.749* (5.417)	.089 (4.791)	.259 (4.511)	-.064 (-1.961)	123	.789	1.164	-14
Large Haddock	-.237 (-1.135)	-.460 (-12.431)	.212 (.816)	-.019 (-.513)	-.001 (-.366)	.878 (3.554)	.010 (.721)	.388 (9.314)	-.108 (-4.650)	123	.853	.781	-21
Small Haddock (Scrod)	-1.748 (-1.517)	-.456 (-12.861)	-.152 (-.542)	.057 (1.845)	.042 (1.047)	2.231 (8.569)	.039 (2.412)	.202 (3.745)	-.009 (-.367)	123	.802	.660	-2
Cod	-2.552 (-2.896)	-.317 (-8.859)	.031 (.155)	.117 (4.232)	.028 (.714)	1.784 (7.081)	.031 (2.060)	.307 (6.477)	-.047 (-2.003)	123	.780	.978	-10
Ocean Perch	.383 (.509)	.004 (.182)	.003 (.018)	-.012 (-.605)	.063 (2.465)	-.076 (-.392)	.013 (1.250)	.176 (3.666)	-.045 (-2.630)	123	.309	.513	-10
Whiting	-9.909 (-5.047)	-.045 (-4.961)	1.442 (3.167)	-.058 (2.189)	-.154 (-2.384)	2.127 (4.296)	.103 (3.665)	.558 (3.360)	-.104 (-2.205)	115	.682	1.352	-20

\* Lagged one month.  $t$  values in parentheses.  
Sources: P, Q, S, I, Z [10]; Y [8]; C [11].

These two months were excluded because Catholics are still obliged to abstain from meat on Lenten Fridays.

After logarithmic transformation, the parameters of equation (1) were estimated using least-squares.<sup>5</sup> The parameters and *t*-values (in parentheses) are shown in Table 1. Quantity landed displayed a negative sign while income showed a positive sign in six out of seven species. The expansion in aggregate personal income has a positive impact on price due, primarily, to population increase. The per capita consumption of most species considered in this study has remained relatively constant over the 1957-67 period [2, pp. 4-8], indicating that fish is not an inferior good. Cold storage holdings seemed to conform to a stock adjustment hypothesis for sea scallops, large haddock, ocean perch, and whiting and to a speculative hypothesis for flounder, scrod, and cod. Imports show a mixture of signs: four positive and three negative.<sup>6</sup> Meat and poultry prices, Lenten demand, and the price of competing fish products have a positive impact on price in six out of seven cases. In general, the parameters seem to conform to a priori theory for all variables except imports.

The (P-B) decree dummy variable exhibited a negative sign for all seven species which is consistent with the hypothesis that the demand curve for fish shifted downward after the P-B decree. For the seven species combined, prices fell approximately 12.5 per cent when weighted by landings. The decline in monthly prices ranged from approximately 21 per cent for large haddock to 2 per cent for scrod as shown in Table 1.

Unfortunately, little can be concluded about the statistical significance of the parameters of equation (1) due to positive autocorrelation in the residuals as evidenced by the Durbin-Watson statistic. However, the estimates remain unbiased and consistent [4] and also agree in direction of sign with a few surveys made of Catholic reaction to the P-B decree [5] [12]. Equation (1) was converted to first-differences in logarithms and the parameters estimated. This procedure eliminated the autocorrelation. However, first-differencing the (P-B) dummy variable yields only *one* observation which shifts the demand function rather than seven when levels are used (i.e., seven months of the P-B decree). Signs for the (P-B) remained nega-

<sup>5</sup> Two other versions of equation (1) were estimated where the variables were first deflated by the consumer price index for all items and then this index was included in the equation as a separate variable. This procedure yielded approximately the same results as shown in Table 1. However the fact that meat, poultry, and fish prices are contained in the consumer price index for all items introduces an unnecessary bias. Hence, these versions were not used.

<sup>6</sup> There are two possible reasons for the poor showing of imports in explaining variation in domestic landing prices. First, there may be an identification problem. That is, higher imports will depress the price, but a higher price will attract more imports. This two-way flow may explain the half-and-half mixture of positive and negative regression signs. Second, fish imports are almost exclusively frozen while domestic landing prices refer to the fresh fish market. New England landed fish usually are marketed to fresh fish outlets such as restaurants and institutions. Hence, there are really two different fish products (fresh and frozen), each not highly price-sensitive to the other. The second explanation is probably the fundamental reason for the weak relation between domestic landing prices and foreign imports [2, p. 7]. Therefore, the parameters for quantity landed (fresh) and quantity imported (frozen) would markedly differ as indicated in Table 1.

tive for all seven species, but the standard errors were as large as the coefficients. Hence, first-differencing of dummy variables is not a satisfactory procedure even though it reduces autocorrelation.<sup>7</sup>

In light of these results, it would appear that the P-B decree had a negative influence on fish prices and therefore industry revenues. If losses in revenue persist, an attrition of both capital and labor from domestic commercial fishing may be produced since wages and the rate of return on capital are already at low levels [2, p. 96]. This may create economic problems for many small communities along the coastal United States.

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<sup>7</sup> Under certain circumstances, it might be feasible to posit two regimens, with first performing one way, and yielding one set of coefficients, before the decree, and another, presumably significantly different, thereafter. Unfortunately, the model cannot be applied to the period after the decree due to the lack of degrees of freedom (i.e., at the time of this study seven observations were available after the decree while the demand equation contains seven independent variables).

### Optimal Growth When the Instantaneous Utility Function Depends Upon the Rate of Change in Consumption

This note is concerned with optimal growth in an economy where planners' preferences are similar to those of Emile Coué, who counselled his followers to believe: "Every day, in every way, I'm getting better and better." E.g., let there be available two alternative consumption sequences, A and B. In A, the sequence of consumption over the first three time periods would be (10, 11, 12) and in B (10, 12, 11). Then a Coué-like planner would prefer sequence A to B. This is, of course, in sharp contrast with the behavior of a Ramsey-like planner who would be concerned with the current level of consumption, rather than its current rate of increase.

Within a numerical planning model, there are a number of devices available to express preference for nonnegative progress, starting from a given initial consumption level. One such device is to add an explicit constraint that the time path of consumption be nondecreasing [4]. A second possibility is to postulate that there is some "subsistence" level of consumption, and that instantaneous utility is a constant elasticity function of the excess over this subsistence level [3, p. 342]. The particular device explored in this paper is to suppose that the instantaneous utility is a constant elasticity function of the *rate of growth* of consumption. This not only implies the optimality of a "gradualist" time path of consumption; it also explicitly constrains the optimal time paths of consumption and investment by their initially given values. The original Ramsey utility maximization model [7] does not necessarily satisfy these initial conditions, and this limits its usefulness in constructing a practical development plan.

#### I. Model Formulation

Both the formulation and the notation here follow those in Chakravarty [3]. For proofs and mathematical details, see [3]. Consider a labor-surplus economy in which the incremental output-capital ratio  $b$  is constant. Let  $K$  and  $C$  represent, respectively, the capital stock and the absolute level of consumption at time  $t$ , and let  $\dot{K}$  and  $\dot{C}$  be their time derivatives. At each point of time, the total product consists of investment plus consumption. Hence:

$$(1) \quad bK = \dot{K} + C$$

and

$$(2) \quad \dot{C} = b\dot{K} - \ddot{K}$$

Now suppose that there is a constant elasticity relationship between instantaneous utility and  $\dot{C}$ . That is, the instantaneous utility is:

$$(3) \quad U(\dot{C}) = \frac{\dot{C}^{1-\eta}}{1-\eta}.$$

The elasticity of utility with respect to  $\dot{C}$  is therefore the following constant:



$$(4) \quad \text{elasticity} = \left[ \frac{dU}{d\dot{C}} \right] \left[ \frac{\dot{C}}{U} \right] = [\dot{C}^{-v}] \left[ \frac{\dot{C}(1-v)}{\dot{C}^{1-v}} \right] = 1 - v$$

To ensure a finite value for the sum of the instantaneous utilities over an infinite planning horizon (which is also necessary for a solution to exist for our utility maximization problem in the present instance), we impose the constraint that  $v > 1$ . Summing up these instantaneous utilities over an infinite time horizon, the maximand is defined as:

$$(5) \quad \frac{1}{1-v} \int_{t=0}^{\infty} (\dot{C})^{1-v} dt = \frac{1}{1-v} \int_{t=0}^{\infty} (b\dot{K} - \dot{K})^{1-v} dt$$

Define new variables  $Z = \dot{K}$ . The maximand is rewritten:

$$(6) \quad \frac{1}{1-v} \int_{t=0}^{\infty} (bZ - \dot{Z})^{1-v} dt$$

Following Chakravarty [3, p. 343], we obtain an Euler-Lagrange equation, the solution of which gives us the optimal time profile of  $Z$ .<sup>1</sup> Note that this time profile is a linear combination of two exponential paths:

$$(7) \quad \text{optimal } Z(t) = Ae^{bt} + Be^{bt/v} = \dot{K}(t)$$

Integrating (7):

$$(8) \quad \text{optimal } K(t) = \frac{A}{b} e^{bt} + \frac{Bv}{b} e^{bt/v} + D$$

and

$$(9) \quad \text{optimal } C(t) = B(v-1)e^{bt/v} + Db$$

We have here three arbitrary constants  $A, B, D$ . We shall show below that  $A$  equals zero. We are then left with the two constants  $B$  and  $D$ . These can be determined by the initial conditions  $C(0)$  and  $K(0)$  by putting  $t=0$  in equations (8) and (9). Since  $C(0) = bK(0) - \dot{K}(0)$ , we have only two independent initial conditions. Thus,  $\dot{K}(0) = B$  is determined as soon as we take account of the information relating to  $K(0)$  and  $C(0)$ . Note that  $C(t)$  has a Fel'dman-Domar-Mahalanobis "gradualist" time shape, the Indian development policy implications of which are discussed by Manne [6]. With a gradualist time path, the relative growth rate of  $C(t)$  approaches  $b/v$  asymptotically. Since the arbitrary constant  $A=0$ , investment  $\dot{K}(t)$  grows at all times at the relative rate  $b/v$ .<sup>2</sup>

<sup>1</sup> Following Chakravarty [3, n. 19, p. 343] we can show that any solution of the Euler equation also satisfies in this instance the second order conditions for a *maximum*. Further, because in this case the Euler equation is linear with constant coefficients, our solutions are defined for all values of " $t$ " and are unique as soon as the boundary conditions of the problem have been taken into account. And hence the solution of the Euler equation is truly optimizing for our problem provided the boundary conditions are appropriately chosen.

<sup>2</sup> If  $\dot{K}(t) = Be^{bt/v}$  and if  $B > 0$ , it is clear that  $\dot{K}(t)$  and any higher order derivatives will be positive for all  $t$ . In particular,  $\dot{K}(t) > 0$ . Furthermore,  $\dot{C}(t) > 0$  for all  $t$ . Hence the nonshiftability conditions analyzed by Barr and Manne [1] will be satisfied automatically.

From the fact that  $A=0$ , it may also be shown that the marginal propensity to save and invest is a constant, the reciprocal of  $v$ . This provides an economically intuitive justification for the restriction that  $v > 1$ . Proof:

$$(10) \quad \frac{\text{Increase in investment}}{\text{Increase in national product}} = \frac{\dot{K}}{b\dot{K}} = \frac{(b/v)Be^{bt/v}}{bBe^{bt/v}} = 1/v$$

## II. *A Proof that $A=0$* <sup>3</sup>

First, suppose that a negative value were assigned to the constant  $A$  in equation (8). Since  $v > 1$  and  $b > 0$ , the term  $(A/b)e^{bt}$  would dominate the term  $(Bv/b)e^{bt/v}$  for sufficiently large values of  $t$ . If  $A < 0$ , there would therefore arrive a point in time after which  $\dot{K}(t) < 0$  over the indefinite future thereafter. To rule out this case (in other words, to rule out the possibility of contracting an indefinitely growing debt), a negative value cannot be assigned to the constant  $A$  in equations (7) and (8).

Suppose now that a positive value were assigned to  $A$ . This could not be an optimal solution to the infinite horizon programming problem. Reason: From (7), together with the known initial value  $\dot{K}(0)$ , we note that the constant  $B = \dot{K}(0) - A$ . Differentiating (9) with respect to  $t$ :

$$(11) \quad \text{optimal } \dot{C}(t) = B(v-1) \frac{b}{v} e^{bt/v}.$$

Therefore

$$(12) \quad \text{optimal } \dot{C}(t) = [\dot{K}(0) - A](v-1) \frac{b}{v} e^{bt/v}.$$

In (12), we see that the lower the value of  $A$ , the higher that of optimal  $\dot{C}(t)$  at all values of  $t$ , and hence the higher the value of the maximand (5). In an earlier paragraph we argued that a negative value cannot be assigned to  $A$ . Hence  $A=0$ .

## III. *Calculation of the Constants $B$ and $D$*

Once it is shown that  $A=0$ , it is clear from (7) that  $B = \dot{K}(0)$ . The constant  $D$  may then be evaluated<sup>4</sup> by inserting the known initial values  $C(0)$  and  $\dot{K}(0)$  into equation (9). This gives:

<sup>3</sup> That  $A$  must necessarily equal zero can also be deduced explicitly from the boundary conditions at infinity which must be satisfied if  $Z(t)$  is to maximize the integral

$$\int_0^{\infty} F(Z, \dot{Z}, t) dt.$$

These conditions are: (a)  $F\dot{Z} \rightarrow 0$  as  $t \rightarrow \infty$ ; (b)  $F - \dot{Z}F\dot{Z} \rightarrow 0$  as  $t \rightarrow \infty$ . With  $v > 1$ , we can show that both the conditions are satisfied for our problem. Further, since  $F$  does not include  $t$  explicitly, the Euler equation can be integrated to give us  $F - \dot{Z}F\dot{Z} = P$  where  $P$  is an arbitrary constant. Combined with (b), it implies that  $F - \dot{Z}F\dot{Z} = 0$  for all  $t$ . Hence  $\dot{Z} = F/P\dot{Z}$ . Since  $\dot{Z} = \dot{K}$  and  $F(Z, \dot{Z}) = (1/(1-v))\dot{C}^{1-v}$ , we have  $\dot{K} = (b/v)Be^{bt/v}$  for all  $t$ . Hence  $A=0$ .

<sup>4</sup> For evaluating  $D$ , we could have used any two of the three initial conditions  $C(0)$ ,  $\dot{K}(0)$ , and  $\dot{K}(0)$ .

$$(13) \quad C(0) = \dot{K}(0)(v-1) + Db$$

and therefore

$$(14) \quad D = \frac{C(0)}{b} - \frac{\dot{K}(0)(v-1)}{b}.$$

With the evaluation of the constants  $B$  and  $D$ , the optimal path has now been constructed for this infinite horizon case. In the case of a *finite* horizon at date  $T$ , we could no longer conclude that  $A=0$ . We would then have three nonzero arbitrary constants  $A$ ,  $B$ , and  $D$  to determine from equations (7)–(9) and the three boundary conditions  $\dot{K}(0)$ ,  $K(T)$ , and  $C(0)$ . The analysis would otherwise be similar, except that the existence of the solution would no longer depend upon assuming that  $v > 1$ .

#### IV. Concluding Comment

By way of conclusion, it should be noted that our model emphasizes strict complementarity between consumption in adjacent time periods.<sup>5</sup> This formulation leads to different results from an additively separable utility function defined on the space of alternative consumption programs. See Koopmans [5]. These two formulations each capture a somewhat different aspect of planners' preferences. Almost surely, a synthesis of these two approaches would be worthwhile.

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<sup>5</sup> Just as this note went to press, we became aware of a closely related paper by F. Brioschi and S. Rossi [2]. These authors have analyzed a utility function in which a negative weight is assigned to the squared change in consumption between successive time periods.

### The Revenue Maximization Oligopoly Model: Comment

Since Professor Baumol's substitution of constrained revenue maximization for profit maximization in the objective function attributed to rational oligopolists, the nature of the relationships between advertising outlay, price, output, and production cost in the oligopoly equilibrium solution has been radically altered [1]. However, because these relationships are clearly articulated neither graphically nor in the mathematical appendix of Baumol's book (even the revised edition), their appreciation has been limited. Moreover, a recent article integrating both the price and advertising outlay variables and touted as *the* general statement of the Baumol model is, as will be shown, but a special case of the Baumol model [2]. In this commentary, we shall present a general model of the sales maximization hypothesis, articulating the above relationships and remedying the shortfalls in generality.

In the text of *Business Behavior, Value and Growth*, Baumol presents his admittedly "partial" sales maximization argument together with its equilibrium advertising outlay-price-output solution. The equilibrium output is defined with production costs and price as variables but with advertising outlay excluded. The equilibrium level of advertising depends on advertising outlay with production costs and presumably output held constant. Total revenue is a standard parabolic function of output, marginal production cost is a positive and increasing function of output, and marginal revenue is a positive but decreasing function of advertising outlay. Given a minimum profit constraint, Baumol demonstrates the impossibility of any combination of advertising outlay and output yielding both a profit above the constraint and maximum sales revenue [1, p. 60].

In the mathematical note, this problem is stated as one of maximizing a total revenue function (price times quantity) subject to a minimum profit constraint which includes both advertising and production outlays. Here, marginal production cost is taken to be positive and relevant to the determination of the equilibrium price and output [1, p. 69].

In an article by R. L. Sandmeyer [2], Baumol is criticized for failing to integrate the sales maximizer's price policy with his advertising policy in describing the equilibrium. This situation is then "remedied" through a graphical model which "allows price, advertising outlay, and product output to change" [2, p. 1078]. Beginning in a no-advertising situation in which total revenue is maximized at an output unconstrained by the profit minimum, Sandmeyer demonstrates that profit in excess of the minimum will be devoted to advertising outlay, generating a new and higher total revenue function, a new price and a new excess profit level which in turn is devoted to advertising outlay, etc., until eventually equilibrium output, price, and advertising outlay are determined. At this equilibrium, the level of profit equals the minimum acceptable.

Two things should be noted with respect to this model. First, it is a "partial" model in that all production and marketing costs are fixed and, consequently, the nonadvertising marginal cost of increasing sales is zero

over the relevant range. Second, because of the implicit zero marginal cost, the equilibrium defined by Sandmeyer occurs at the peak of one of the total revenue functions, i.e., where marginal revenue is zero—a solution which is inconsistent with the basic equilibrium conditions of the model as stated by Baumol [1, pp. 61, 69].

In the following model, the equilibrium for a revenue maximizer will be shown when price, cost, output, and advertising outlay are all free to vary. This model will be referred to as the general Baumol model of which both Baumol's "partial" presentation and Sandmeyer's model are special cases.

Define, as does Baumol,

$D(x, a)$ —demand function representing the price which will be paid when  $x$  units are offered after  $a$  dollars of advertising outlay;

$\pi$ —minimum acceptable profits;

$C(x)$ —total cost of production function;

$A(a)$ —total cost of advertising function;

$x \cdot D(x, a)$ —total revenue function representing the maximum total revenue saved from selling  $x$  units after  $a$  units of advertising.

Given these definitions, we maximize the total revenue function, subject to a profit constraint:

$$(1) \quad x \cdot D(x, a) - \pi - C(x) - A(a) \geq 0.$$

Using the Lagrange multiplier technique (and Kuhn-Tucker conditions), we have:

$$(2) \quad \frac{\partial}{\partial x} \{x \cdot D(x, a) - \lambda[x \cdot D(x, a) - \pi - C(x) - A(a)]\} \leq 0,$$

$$(3) \quad \frac{\partial}{\partial a} \{x \cdot D(x, a) - \lambda[x \cdot D(x, a) - \pi - C(x) - A(a)]\} \leq 0.$$

Differentiating (2) and (3), solving for  $\lambda$ , and substituting, we have, for interior points,

$$(4) \quad x \frac{\partial D}{\partial a} \cdot \frac{dC}{dx} = D \frac{dA}{da} + x \frac{\partial D}{\partial x} \cdot \frac{dA}{da},$$

which is the statement of the equilibrium condition. Letting  $TR(x, a) = x \cdot D(x, a)$ , this equilibrium condition (4) can be written as:<sup>1</sup>

$$(5) \quad \frac{\partial TR}{\partial a} \left( \frac{dC}{dx} \right) = \frac{\partial TR}{\partial x} \left( \frac{dA}{da} \right).$$

Note that, by assumption, the Baumol formulation requires the following conditions,

$$\frac{\partial TR}{\partial a} > 0, \quad \frac{dC}{dx} > 0, \quad \text{and} \quad x \frac{dA}{da} = 1,$$

<sup>1</sup> This condition can easily be generalized to allow for more than one output and advertising outlay. See [1, pp. 68–69].

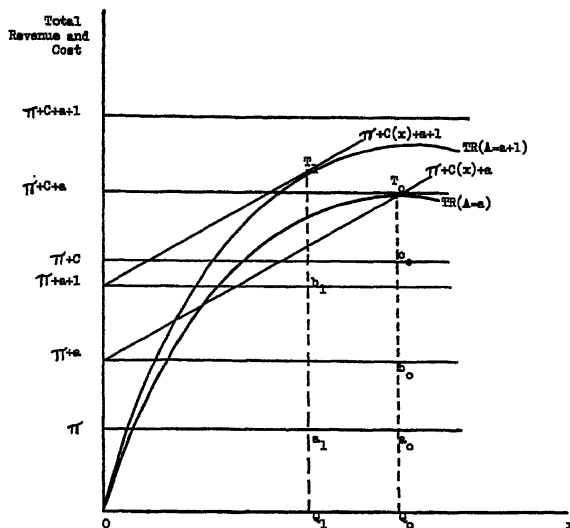


FIGURE 1

[1, pp. 54, 59] which, in turn, necessitate  $\partial TR/\partial x > 0$ . This is to be compared with the  $\partial TR/\partial x = 0$  claimed by Sandmeyer as a characteristic of the equilibrium solution.

Graphically, Sandmeyer's equilibrium position is shown as  $T_0$  in Figure 1. With the  $TR$  functions representing the relationship of total revenue to output at different levels of advertising outlay, the minimum profit constraint represented by  $\pi$ , and the production cost function implied by the horizontal curve  $\pi + C$ , this solution gives an output of  $OQ_0$ , a price of  $T_0Q_0/OQ_0$ , and advertising outlay of  $c_0T_0 = a_0b_0$ . Clearly, this solution implies  $\partial TR/\partial x = dC/dx = 0$ , which, as noted above, is inconsistent with the requirements of the generalized Baumol model.

The solution of the general Baumol model is also shown in Figure 1. Again, the  $TR$  functions represent a family of total revenue functions at different levels of advertising outlay and the level of minimum profit is given by  $\pi$ . In this case the production cost function is implied by  $\pi + C(x) + a$ . For each level of advertising outlay, a new total cost function (including  $\pi$ ) is observed. At output  $OQ_0$ , the advertising outlay is  $a_0b_0 = c_0T_0$ , total production cost is equal to  $b_0T_0$ , and total revenue equals total cost including the minimum profit constraint. These conditions, then are true of both the Sandmeyer model and the general Baumol model at output  $Q_0$ . However, while the sales maximizer is in equilibrium at  $Q_0$  in the Sandmeyer model, he is *not* in equilibrium in the general Baumol model. The next unit of advertising will be purchased, output will be cut back from  $OQ_0$  to  $OQ_1$ , the price of the output will be raised from  $T_0Q_0/OQ_0$  to  $T_1Q_1/OQ_1$ , and total production cost will decrease from  $T_0b_0$  to  $T_1b_1$ . The change will be undertaken because total sales revenue is increased from  $T_0Q_0$  to  $T_1Q_1$ .

In general, then, the sales maximizer in the general Baumol model will

demonstrate a smaller output, a greater advertising outlay, a higher price, and a greater sales volume than will the sales maximizer in the Sandmeyer version of the Baumol model. With  $dC/dx > 0$ , the oligopolist will find it in his interest to allocate profit surplus from production to advertising in the process of generating sales revenue. Moreover, in the general Baumol model the tendency toward high product price, excessive advertising outlay, and more intense output restriction will be positively related to the elasticity of marginal cost.

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### Incidence of the Corporation Income Tax in U.S. Manufacturing: Comment

In responding to previous critiques of our incidence study [4], we have conceded that our initial effort should eventually come to be replaced by a more complex approach, involving a structural model in which price, wage, and shifting behavior are specified, and all equations are identified. While the required data are exceedingly difficult to obtain, such a reformulation may eventually be forthcoming. Such a model may not only provide better information on total shifting, but also show how shifting comes about and what "direction" it takes. It is with great anticipation, therefore, that one follows beyond the opening pages of a recent article by R. J. Gordon, where such an approach appears to be taken.<sup>1</sup> But as the paper proceeds, it becomes apparent that no such improvement is offered.

#### *Tax-less Model*

Gordon begins with a model for a tax-less world. He defines profits as sales minus costs, with costs a function of quantity, wage rates, and material prices. Sales equals product price times quantity, where price is determined by a behavioral equation involving mark-up prices. This assumption is worth testing, although other behavior hypotheses might have been used as well. In equation (7), Gordon attempts to present the system in reduced form. Some of the variables in (7) being unavailable, he proceeds to make certain substitutions, thus arriving at equation (12),

<sup>1</sup> See [2]. To simplify and to permit reference to our model, we consider the Gordon model only in its rate of return formulation.

which involves observable variables only. Feeling that (12) does not allow sufficiently for cyclical responses, certain other variables are added to arrive at equations (13) and (14), which offer his final tax-less system.

Equation (7) may be accepted as the proper reduced form of the system as applied to a micro setting. But difficulties arise once the data are aggregated into macro terms. Taking Gordon's amended form (after substitutions) as given in equation (12), and rewriting it as

$$(12^*) \quad Z'_t = \alpha_1 p^o_t Q_t + \alpha_2 p^o_t Q^*_t + u_t$$

we have profits as a function of the general price level, quantity sold and capacity. We take no issue with the  $Q^*$  term which defines production capacity. But we question the use of the current quantity variable  $Q_t$  and of the current price level  $p^o_t$  as exogenous macro variables. As will be noted presently, this deficiency in the tax-less model is of particular importance for the later estimation of shifting.

The difficulty is compounded when, in accounting for cyclical factors, percentage changes in price and quantity (involving current price and quantity values in manufacturing) are introduced as additional variables. The introduction of the observed price variable destroys much of whatever benefit was derived initially by working with a behavioral price equation. Indeed the use of price as an exogenous variable is incompatible with the mark-up hypothesis used earlier in the system.

After a promising beginning with a behavioral price equation, we thus end up with an estimating equation which is a far cry from being the reduced form of a refined structural system. The rate of return turns out to be simply a function of *current* quantity and price variables (or changes therein) and of capacity. It is *not* a reduced form of the initially outlined or any otherwise defined structural system.

### *Model with Tax*

Having arrived at his final equation for the tax-less world, Gordon then adds his tax variable thereto. Note that the tax variable is not introduced into the structural system as part of the price equation, but added at the end. Gordon's model, like ours, can thus not be used to explain the mechanism or direction of shifting. It can only attempt to measure total shifting. To obtain the fuller evidence, the tax variable must be integrated into the behavioral (price, wage, or other) equations. Such a step would have constituted a major improvement over our initial analysis, but it was not taken.

Our estimating equation has been criticized for not being derived rigorously from a satisfactory structural system. But Gordon's equation, it seems to us, is even less satisfactory. As noted before, equation (12<sup>\*</sup>) treats quantity  $Q_t$  and price level  $p^o_t$  as exogenous although in fact they are not. As the tax variable is added to this equation, its coefficient is underestimated since part of the tax effect will tend to operate through  $Q_t$  and  $p^o_t$ .<sup>3</sup>

<sup>3</sup> It would have been interesting to estimate the tax coefficient in this form. It recalls a model used in our earlier work which involved  $Q$  and which was discarded because of the endogenous nature of  $Q$ . The result of this model recorded shifting to 90 per cent in the first period, and of minus 30 in the second.



And this difficulty is accentuated by adding percentage changes in manufacturing prices and quantities as new variables when moving to equations (13) and (14). Again these variables are not exogenous but are subject to the operation of the tax effect. No wonder then that a substantially lower shifting coefficient is arrived at. Gordon's results are thus derived from a questionable tax-less model; and even if this model is accepted for a tax-less world, it will measure only part of the tax effect when the tax variable is appended.

### *Critique of K-M Model*

Gordon's comments on our model review earlier critiques which have been discussed before, and which need not be responded to again.<sup>3</sup> But a new point is raised in his critique of our estimating technique. Substituting his iterative procedure for our instrumental variable estimation, Gordon finds that the shifting coefficient is reduced from 1.34 to .92, but remains significant. While the conclusion of substantial shifting thus remains, this modified result is of interest. At the same time, it is not evident that Gordon's procedure is superior in this particular case. As we have noted before, the circumstances of our model are such as to render the instrumental variable approach applicable [4, Table 6-1, 1.5, p. 44; and note 4, p. 46].

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<sup>3</sup> See the contributions by Richard E. Slitor and Richard Goode, as well as our rejoinder in [3]. Also see [1] and our rejoinder in a forthcoming issue of the *JPE*.

While the difficulties posed by Gordon's model are similar in some respects to those posed by the Cragg-Harberger-Mieszkowski adaptation of our model, our objections are magnified in Gordon's case. Whereas Cragg-Harberger-Mieszkowski merely introduce a current measure of total employment, Gordon goes much beyond this and introduces current values of quantity and price in manufacturing.

### **Incidence of the Corporation Tax in U.S. Manufacturing: Reply**

Have corporations been able completely to avoid the burden of the corporation income tax by means of discretionary price increases, which raise their gross-of-tax rate of return above the level which would have

occurred without the tax? In their original study [4] Krzyzaniak and Musgrave (K-M) claimed that indeed manufacturing corporations have succeeded in doing so, while in my paper [3] I found no evidence that the burden of the corporation income tax has been shifted. I suggested that K-M had been led astray by ignoring a fundamental economic phenomenon—that the productivity of corporate assets in manufacturing increased by more than 60 per cent between the late 1920s and the 1950s and, by almost any theory of pricing, this would have allowed a substantial increase in the rate of return on assets even if the corporate tax had never been introduced.<sup>1</sup> In my regressions the productivity of capital entered as an independent variable explaining the rate of return and reduced the coefficient on the tax variable nearly to zero. In K-M's regressions, on the other hand, nothing like the productivity of capital appeared, and hence the only variable with a positive secular trend, the tax rate, was called upon to provide the entire explanation of high postwar profits and therefore appeared with a coefficient significantly greater than one.

In their comment K-M ignore the economic role of the productivity of capital and concentrate on alleged statistical inadequacies of my model, which, they imply, constitute the only reason for the dramatic reduction in the tax-shifting coefficient from .921 in their model to .110 in mine.<sup>2</sup> K-M's criticisms are merely conjectural, however, and the following paragraphs present further econometric evidence which rebuts their comments and supports my original conclusions.

1. K-M claim that the price change variable in my model ( $\Delta p$ ) is not exogenous but rather is subject to the operation of the tax effect and disguises part of its influence.<sup>3</sup> It is easy to see from a simplified example, for which data are presented in Table 1, why the inclusion of the  $\Delta p$  variable need not bias the tax-shifting coefficient. Consider a world in which the margin of profits on sales is 10 per cent in period 1 before the corporate tax is introduced. Then in period 2 a 50 per cent corporate tax is imposed.

<sup>1</sup> The average ratio of sales to assets in manufacturing corporations was 1.59 in 1950–59 compared with .97 for 1925–29. In a world of perfect competition and a CES production function, for instance, the rate of return ( $r$ ) would be related to the productivity of capital ( $Y/K$ ) by the following formula:

$$r = \alpha \left( \frac{Y}{K} \right)$$

where  $\sigma$  is the elasticity of substitution and  $\alpha$  is the distribution parameter. Thus the rate of return would increase in proportion with the productivity of capital if  $\sigma=1$ , and would remain unchanged only if  $\sigma=\infty$ .

<sup>2</sup> See equations (I-1C) and (I-3K) in [3, pp. 742–43]. The .921 tax-shifting coefficient was obtained for the K-M model using the same nonlinear estimation technique applied in my approach.

<sup>3</sup> Few would deny that  $\Delta p$  belongs in a regression attempting to explain book profits, since an increase in output prices will *ceteris paribus* create inventory valuation profits (it is to eliminate this component of profits, after all, that the Commerce Department makes its inventory valuation adjustment). Since the *Statistics of Income* data used in my study are not adjusted for inventory valuation profits, and since a dynamic inventory model was considered beyond the scope of the study, I introduced the  $\Delta p$  variable in *ad hoc* fashion.

TABLE 1  
A HYPOTHETICAL EXAMPLE

Variables	Periods			
	1	2	3	4 and after
1. Tax rate	.00	.50	.50	.50
2. Percentage change in price	.00	.10	.00	.00
3. Pre-tax profit rate if shifting successful	.10	.20	.20	.20
4. Pre-tax profit rate if shifting unsuccessful	.10	.20	.10	.10

If corporations fully shift the tax, they raise price by 10 per cent and achieve a gross-of-tax profit margin of 20 per cent.<sup>4</sup> But what happens in period 3 and afterwards on the assumption that the tax rate stays constant at 50 per cent and price is stable? If corporations are successful in shifting, the pre-tax profit rate remains at 20 per cent. A regression of the profit rate on the data in lines 1 and 2 would yield a significant positive coefficient for the tax rate and a zero coefficient for price change. If, on the other hand, labor unions fight back and the profit margin is forced down to its previous value of .10, a regression would yield a significant positive coefficient on price change and an insignificant tax-shifting coefficient. The latter case describes the results of my regressions in [3]. In short, the price change variable does not *by itself* disguise the influence of the tax effect, since the price change and tax variables are correlated *only* in years of alterations in the tax rate, while in subsequent years the tax rate remains steady while the price change variable returns to its former values.

If the previous paragraph is correct, the removal of the  $\Delta p$  variable from my regression equations would lower the  $\bar{R}^2$  but would not alter the tax-shifting coefficient. If K-M are right, the tax-shifting coefficient would rise significantly towards the high values which they report. In Table 2 my original regression (I-3K [3, p. 743]) is shown on line 1, while in line 2 both the  $\Delta p$  and  $\Delta Q$  variables are eliminated. My contention is supported and K-M's rejected, for the tax-shifting coefficient  $\alpha_5$  does not rise; it remains insignificantly different from zero. Thus the zero tax-shifting conclusion is maintained even with the model of my equation (12\*), which is directly derived from the behavioral equations (1)–(10) and in which no *ad hoc* variables appear (when (12\*) is standardized by assets  $K_t$  and includes the shifting parameter  $\alpha_5$ ).

2. But K-M also "question the use [in 12\*] of the current quantity variable  $Q_t$  and the current price level  $p_t^e$  as exogenous macro variables." They would not be so dubious if they had taken time to notice that all my results are presented in two forms, the first standardized by assets and the second by revenue. As shown in line 3 of Table 2, the form of my model standardized by revenue  $R_t$  gives exactly the same evidence of zero shifting as the form standardized by assets in line 2, even though in line 3 the quantity

<sup>4</sup> To simplify the example, the elasticity of demand for corporate output is assumed to be zero. Changing this assumption would not affect the point being made in this paragraph.

TABLE 2—EFFECT OF REMOVAL OF  $\Delta p$  AND  $\Delta Q$  VARIABLES

( $t$ -coefficients in brackets)  
 Period of fit: 1925-41+1946-62  
 Method of estimation: Nonlinear

	Dependent Variable	Independent Variable					
	$\frac{Z_t^*}{K_t}$	$\frac{R_t}{K_t}$	$\frac{R_t^*}{K_t}$	$\frac{\Delta p_t}{p_t}$	$\frac{\Delta Q_t}{Q_t}$	$v_t$	
1.		.176 [8.94]	-.062 [-4.48]	.043 [1.54]	.056 [3.57]	.110 [1.22]	$\bar{R}^2 = .962$ $DW = 1.67$ $SE = .0100$
2.		.201 [7.89]	-.080 [-4.46]			.082 [.52]	$\bar{R}^2 = .936$ $DW = 1.11$ $SE = .0127$
	$\frac{Z_t^*}{R_t}$	Constant	$\frac{R_t^*}{R_t}$				$v_t$
3.		.202 [10.03]	-.081 [-6.01]			.080 [.52]	$\bar{R}^2 = .738$ $DW = 1.11$ $SE = .0117$

$Q_t$  and price level  $p_t^e$  variables to which K-M object *cancel out and thus do not appear at all*. Since the results in line 2 and line 3 are so similar and since the latter does not contain the objectionable variables, these could not possibly have been a source of bias in line 2. In short, the fitting in lines 2 and 3 of (12\*), which is the "reduced form of a refined structural system," yields consistent estimates of zero shifting with *either* standardization, and the addition of the  $\Delta p$  and  $\Delta Q$  terms in the original paper did not bias the tax-shifting coefficient, as is evident from a comparison of lines 1 and 2 in Table 3, but instead improved the explanation of profit behavior.

3. In line 3 of Table 2 the profit share is explained by a constant and the inverse of utilization. K-M might contend that utilization, too, is an endogenous variable. Since current utilization depends partly on the level of current investment, the coefficient of utilization in line 3 would be biased if current investment depends in turn on current profits, since the utilization variable in the profits equation would then be correlated with the error term. Although the influence of profits on investment is a controversial topic, the weight of recent econometric evidence suggests that output is the only *current* variable which has an appreciable influence on investment, and that the effect of profits, if any, operates with a considerable lag.<sup>5</sup> This evidence implies that the coefficient on utilization in line 3 is not biased.

<sup>5</sup> In a cross-section study Eisner concluded that "The true structural role of profits is . . . seen in the low (even negative) coefficients of the profits variable in the between-group regres-

4. K-M are much too sanguine about the possibility of obtaining "fuller evidence" by integrating the tax variable into the behavioral equations. Consider, for instance, a firm aiming at 100 per cent shifting. It might examine equation (15) [3, p. 738] to decide by how much profits should be increased following a boost in the tax rate, and then convert this into a pricing rule equivalent to my equation (5) on page 736:

$$(5^*) \quad p = c^* + \left( \frac{M}{1 - \alpha_s v} \right) c^* - \left( \frac{\alpha_s v}{1 - \alpha_s v} \right) d$$

Here  $p$  is price,  $M$  the markup margin ( $M = m - 1$  in the notation of [3]),  $\alpha_s$  is the shifting parameter,  $v$  is the tax rate,  $c^*$  is average cost at capacity, and  $d$  is unit depreciation and interest. This rule states that price will be set equal to average cost at capacity plus a markup fraction adjusted for shifting, minus a correction factor necessary to reduce the computed price for the fact that the markup fraction  $M$  includes a nontaxable portion  $d$  which will not be shifted as implied by the second term. Note that (5\*) meets K-M's criterion of a pricing rule where the tax variable is integrated into a behavioral equation, yet even so it leads not to "fuller evidence," but to exactly the same regressions used in lines 2 and 3 of Table 2 and hence exactly the same results.

Nor can we learn anything new from testing (5\*) directly, for  $c^*$  is an endogenous variable; any alteration in tax rates in a world of shifting would affect materials prices, which are a sizable fraction of  $c^*$ , and thus a test of (5\*) would substantially disguise the extent of true tax shifting.

5. The final point made by K-M is that their instrumental variable estimation technique is not necessarily inferior to the nonlinear method used in [3]. An interesting test of the two alternative methods is a prediction experiment. The K-M model has been fitted with both techniques through 1959, and we can see which set of fitted coefficients best predicts the actual values of the rate of return for the years 1960-65. The instrumental equation to be extrapolated is K-M's standard model from [4]:

$$(A) \quad r_t^m = .286 + .404\Delta C_{t-1} - .527V_{t-1} - .833J_t + 1.339v_t^m$$

where the notation is explained on page 741 of my original paper [3]. The nonlinear equation extrapolated is my (I-1C), which was fitted in [3] to exactly the same data as equation (A) above:

$$(B) \quad r_t^m = \frac{.373 + .432\Delta C_{t-1} - .800V_{t-1} - .941J_t}{1 - .921v_t}$$

But we cannot calculate predictions from (A) as it stands. Notice that in (A) the dependent variable  $r_t^m$  appears on the right-hand side, so that  $r_t^m$  cannot be extrapolated from equation (A) without *advance knowledge* of the value of  $r_t^m$  itself.

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sions" [2, p. 246]. Using new flexible techniques for estimating distributed lags, Bischoff has found that changes in output affect investment immediately, but non-output variables appear to influence equipment expenditures with a considerably longer lag [1, p. 54].

TABLE 3—RELATIVE PREDICTIVE POWER OF ALTERNATIVE ESTIMATION METHODS APPLIED TO K-M MODEL

Year	$r^m_t$			Prediction Error	
	Observed	Predicted by (A*)	Predicted by (B)	(A*)	(B)
1960	.120	.109	.118	.011	.002
1961	.116	.120	.127	-.004	-.011
1962	.125	.102	.114	.023	.011
1963	.135	.084	.101	.051	.034
1964	.146	.117	.130	.029	.016
1965	.175	.119	.130	.056	.045
Variance of the predictions (=sum of squared errors)				.007329*	.003681*

\* Sum of squared errors calculated from unrounded data, not the rounded data presented above.

Instead, the predictive power of (A) and (B) can be compared only after (A) has been rewritten in its reduced form:

$$(A^*) \quad r_t = \frac{.286 + .404\Delta C_{t-1} - .527V_{t-1} - .833J_t}{1 - 1.339v_t}$$

Table 3 compares the results of this comparative extrapolation for the years 1960-65.<sup>6</sup> Both (A\*) and (B) predict very poorly, as all of the numerous critics of K-M's model would have expected. But the variance of the prediction for the nonlinear parameters of (B) is only half the variance for the instrumental parameters of (A\*).<sup>7</sup> This is further evidence that the nonlinear approach is superior to the K-M instrumental variable technique.

Extrapolation experiments, in fact, can be used to reveal the inadequacy of K-M's model, not just their estimation method. We can compare the sizable prediction errors in Table 3 with the errors generated by my model, as presented in Table 4. The first three columns of Table 4 show the observed value, predicted value, and error for 1960-65 for equation I-3K of my original article (in which cash flow  $Z_t^*$  is standardized by assets). The next set of three columns shows the same information for I-3R (where  $Z_t^*$  is standardized by revenue).<sup>8</sup> The error variances

<sup>6</sup> Data for all variables for 1960-65 were obtained from the sources listed in K-M's book [4, pp. 72-75]. The new data were carefully cross-checked for earlier years with the original K-M data to avert the possibility that the poor predictions in Table 3 were due to inconsistent data. The effective tax rate  $v_t$  was used in (A\*) while the statutory rate was used to estimate and extrapolate (B), but this is not a cause of the differences illustrated.

<sup>7</sup> This difference, while it appears to be substantial, is not statistically significant. The ratio of the variances is 1.99. The critical value for  $F(5, 5)$  at a five per cent level of significance, however, is a much greater 5.05.

<sup>8</sup> For this extrapolation, of course, equations (I-3K) and (I-3R) were refitted for the period ending in 1959, with practically no change in the fitted coefficients or  $\bar{R}^2$ .

TABLE 4—PREDICTIVE POWER OF GORDON MODEL

Year	$Z_t^*/K_t$		Prediction Error	$Z_t^*/R_t$		Prediction Error
	Observed	Predicted by (I-3K)		Observed	Predicted by (I-3R)	
1960	.144	.154	-.011	.102	.109	-.007
1961	.143	.147	-.005	.105	.107	-.002
1962	.152	.158	-.006	.109	.114	-.005
1963	.158	.159	.001	.115	.116	.001
1964	.162	.160	.002	.118	.117	.001
1965	.169	.165	.004	.123	.121	.002
Variance of predictions (=sum of squared errors)			.0001982*			.0000768*

\* Sum of squared errors calculated from unrounded data, not the rounded data presented above.

in Table 4 are much smaller than those in Table 3 based on the K-M model. In fact, the most favorable extrapolation in Table 3, calculated from parameters fitted by nonlinear estimation to the K-M model, has an error variance fully 18.6 times as large as my equation I-3K (standardized by assets) and 47.9 times as large as equation I-3R (standardized by revenue). Both of these ratios are more than large enough to pass an F-test, indicating significantly better predictions with my model than with K-M's.<sup>9</sup>

Yet another confirmation of the inadequacy of the K-M model can be obtained by extending the period of fit of the K-M equation back before its initial year of 1935. As predicted in my article [3, p. 744, middle paragraph],

TABLE 5—K-M STANDARD EQUATION FITTED FOR 1929-42+1948-59

(t-coefficients in brackets)  
Method of estimation: Instrumental

$$\text{Equation: } r_t^m = .220 - .067 \Delta C_{t-1} - .549 V_{t-1} - .417 J_t + 1.380 v_{t-1}^m$$

$$[3.42] [-.31] \quad [-2.71] \quad [-1.69] \quad [7.55]$$

$$R^2 = .917 \quad DW = 1.49 \quad SE = .023$$

Years	$r_t^m$		Error
	Observed	Predicted	
1929	.100	.073	.027
1930	.041	.066	-.025
1931	.004	.058	-.054
1932	-.014	.027	-.041
1933	.016	.008	.008
1934	.036	.025	.011

<sup>9</sup> The same conclusion would have been obtained if the coefficients of variation had been compared, since the means of the dependent variables in Tables 3 and 4 are roughly the same.

this causes the  $\Delta C_{t-1}$  variable to change sign and become insignificant. The  $J_t$  variable borders on insignificance, and the resulting equation has large residuals during the early 1930s (see Table 5). The failure of the K-M model accurately to predict the collapse of profits between 1929 and 1932 or the boom in profits in 1963-65 again confirms previous critiques of the K-M model and suggests that any attempt to explain the rate of return in manufacturing must take account of changes in capacity utilization and in the productivity of capital.

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\* The author is assistant professor of economics at the University of Chicago.

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#### Lognormality and Concentration: Comment

A recent article by I. H. Silberman [3] proposes a test of the hypothesis that firm sizes have the lognormal distribution. He performs a considerable service by pointing out the characteristics and limitations of the data used in this field. His conclusion that the (two parameter) lognormal distribution cannot be considered a universally valid description of size distributions is sensible and is in agreement with some other work [2].

The particular statistical test employed in [3] is novel and is in the right spirit in that it allows one to concentrate attention on the tail of the distribution. There are, however, several difficulties associated with the test. It is the purpose of this note to spell these out.

Silberman proceeds as follows. Assume that we have picked an integer  $q$  and are interested in the  $q$  largest among  $n$  firms in an industry. Let  $x_0$  be the size such that the fraction of firms greater than  $x_0$  is  $q/n$ . If the ordered sizes of firms are denoted by  $x_1, x_2, \dots, x_n$ , the top  $q$  concentration ratio  $R$  is

$$(1) \quad R = \frac{\sum_{i=n-q+1}^n x_i}{\sum x_i}$$



which is denoted by  $m(x_0)/m$  in Silberman's notation. If the lognormal distribution is fitted to the sample, the corresponding theoretical value of  $R$ , say  $R_0$ , can be computed from the lognormal. Letting  $\sigma_R$  represent standard deviation of  $R$ , we form the test quantity

$$(2) \quad z = \frac{R - R_0}{\sigma_R}.$$

which is assumed to be normally distributed.

The shortcomings of this procedure are as follows.

1. Since, for a given industry, only a single value of  $R$  can be computed, and since Silberman does not derive its sampling distribution, the only way of obtaining an estimate of  $\sigma_R$  is to perform sampling experiments in which lognormal samples are computed from which a sample of  $R$ 's and thus  $\sigma_R$  can be experimentally obtained.

2. The test is based on the assumption, not otherwise supported, that  $R$  is normally distributed with  $N(R_0, \sigma_R^2)$ . This is clearly not sufficient for asserting that the sampling distribution of  $z$  is normal since  $R_0$  is computed from a lognormal distribution the parameters of which themselves were estimated from the sample. Hence, really the sampling distribution of  $(R - R_0)/\sigma(R - R_0)$  is relevant, contrary to the author's treatment of  $R_0$  as a constant.

The difficulty with Silberman's approach may be illustrated by the following example. Suppose we have a sample of individuals and we are interested in making some assertion about the normality of their weights. As a first step we might compute the mean,  $\mu$ , of a fitted normal distribution. Secondly, we might obtain (by whatever means; the precise method being irrelevant for the present argument)  $\sigma_{\bar{x}}$ , i.e., the standard deviation of the sample mean. Next we would form the quantity  $z = (\bar{x} - \mu)/\sigma_{\bar{x}}$  and test  $z$  using tables of the normal distribution. In the present example the proposed method would not work at all since the normal distribution is usually fitted by setting  $\mu = \bar{x}$  and thus  $z = 0$ . In Silberman's case the quantities  $R$  and  $R_0$  are not sample and (fitted) population moments respectively but rather some functions thereof, i.e., concentration ratios, but it is not clear why the test should be more acceptable in that case than in the naive example outlined above since the basic procedure is the same. In general, this procedure might then be expected to bias the test against the rejection of lognormality.

3. It is easy to demonstrate in simple cases that the sampling distribution of  $R$  is not normal. We shall do this for the simple case in which the sample consists of two firms drawn from the Pareto distribution and the case in which we want the concentration ratio for the top firm.  $R$  then is

$$R = \frac{x_2}{x_1 + x_2} \quad 1 + \frac{x_1}{x_2}$$

Our argument may be conducted in terms of the quantity  $x_1/x_2$ . We seek,

for every number  $0 < w < 1$ , the probability  $P(x_1/x_2 \leq w)$ . Since  $x_1$  and  $x_2$  are order statistics, the joint density of  $x_1$  and  $x_2$  is<sup>1</sup>

$$(3) \quad h(x_1, x_2) = 2f(x_1)f(x_2)$$

where  $f(x_1)$  and  $f(x_2)$  are the individual densities of the observations. The required probability is the integral of (3) over the region  $C$  given by

$$C = \left\{ \frac{x_1}{x_2} \mid \frac{x_1}{x_2} \leq w \right\}$$

where  $0 < w < 1$ . Thus

$$(4) \quad P\left(\frac{x_1}{x_2} \leq w\right) = \int_C h(x_1, x_2).$$

Substituting the Pareto density,  $f(x) = ak^a/x^{a+1}$ , (4) becomes

$$(5) \quad P\left(\frac{x_1}{x_2} \leq w\right) = 2 \int_{k/w}^{\infty} \int_k^{wx_1} a^2 \frac{k^{2a}}{x_1^{a+1} x_2^{a+1}} dx_1 dx_2 = w^a$$

where  $a$  and  $k$  are parameters of the Pareto distribution. We are interested ultimately in the distribution of  $y = x_2/x_1 + x_2$  the density of which,  $g(y)$ , becomes after simple transformations

$$g(y) = \frac{a}{y^2} \left( \frac{1}{y} - 1 \right)^{a-1}$$

which is not normal, indeed it is not even symmetric.<sup>2</sup>

4. Clearly the integrations in the above paragraphs become very much more difficult if we have more observations and assume lognormality. It might be entirely possible that as a practical matter the distribution of  $z$  may be closely approximated by the normal. It would therefore have been desirable if the distribution of  $z$  had been tested against  $N(0, 1)$  by, say, the Kolmogorov-Smirnov test. This would have been, it seems, entirely feasible, since a sample of  $z$ -values had in effect been computed for the sampling experiments which were used for obtaining  $\sigma_R$ .

In conclusion, it appears to me that some further consideration of these issues might result in substantial strengthening of Silberman's conclusions.

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#### REFERENCES

1. A. M. MOOD AND F. A. GRAYBILL, *Introduction to the Theory of Statistics*. New York 1963.

<sup>1</sup> See [1, 240-1].

<sup>2</sup> It must be noted that Silberman also performs another, nonparametric, test of his hypothesis and finds its conclusions substantially consistent with those of the main test in his paper.

2. R. E. QUANDT, "On the Size Distribution of Firms," *Am. Econ. Rev.*, June 1966, 56, 416-32.
3. I. H. SILBERMAN, "On Lognormality as a Summary Measure of Concentration," *Am. Econ. Rev.*, Sept. 1967, 57, 807-31.

### Lognormality and Concentration: Reply

I appreciate Professor Quandt's kind comments regarding the spirit of the technique I employed in testing for lognormality, as well as the reasonableness of my findings.

Quandt's paper makes two major points. The first is that the hypothetical concentration ratio (Quandt calls it  $R_0$ ) is not a constant (as I have assumed), since it is computed from a lognormal distribution whose parameters were estimated from the observed distribution. Therefore, he argues that I should have concerned myself with the sampling distribution of  $(R - R_0)/\sigma_{(R - R_0)}$  rather than of  $(R - R_0)/\sigma R$ .

I am not at this time prepared either to affirm or to deny that my procedure biases the test against the rejection of lognormality. Colleagues with statistical training support my position that treatment of  $R_0$  as a constant is permissible since I only claimed to have performed a *conditional* test, i.e., considered only samples from a population whose parameters are the observed mean and variance of the logarithms of the size of firms and establishments.

I believe, however, that I can shed some light on Quandt's second major point, i.e., that my argument would have been strengthened had I determined whether the distribution of  $z$  can be approximated by  $N(0, 1)$ . I have subsequently performed such an analysis employing the Kolmogorov-Smirnov test (as suggested by Quandt). The findings are quite clear—in virtually all cases, at the 5 per cent level of significance (two-tailed test), the null hypothesis is rejected. Indeed, the distribution appears to be highly skewed, generally with 65-75 per cent of the sample values having negative signs. In fact, under such circumstances it would not be unusual for a value of  $z = -2.5$  to fall within the area of acceptance. Interestingly though, the shape of the distribution is such that only in rare cases would a value of  $z = 1.96$  fall within the region of rejection.

This observation goes a long way toward explaining the results of the distribution-free test of significance reported on page 813 of my original paper. There I reported that for eighty-two 1958 value of shipments-company size distributions, the effect of employing the nonparametric test rather than the normal approximation was a net change in the classification of three industries from "not lognormal" to "lognormal."

Specifically, the null hypothesis was tested for 323 individual, observed ratios using the distribution-free test of significance. In 291 cases, or 90 per cent of the cases tested, acceptance or rejection was identical with the de-

termination based on the normal assumption. In only 32 cases did the two tests yield conflicting results. In 24 of these, the nonparametric test indicated acceptance, while the normal approximation indicated rejection; in eight cases the former indicated rejection while the latter indicated acceptance.

Our classification of an industry as lognormal or not lognormal, however, was based upon the pattern of acceptance or rejection at the top 4, 8, 20, and 50 concentration levels for that industry. Thus, if the tests of significance differ with regard to the top 4 ratio, but both indicate rejection at the top 50 level, the industry classification as not lognormal is unaffected by the use of the nonparametric test. But if an industry has been classified lognormal based on the normal approximation, and the nonparametric test indicates a significant difference at any concentration level, that industry is no longer considered lognormal.

Of the 82 industries studied, 11, or 13 per cent had their classifications changed based on the distribution-free test. In all cases but one, the changes were for industries having relatively few firms. Seven industries had their classification changed to lognormal, while four became not lognormal. The result, as reported above, was a net change of three industries to lognormal. No change in the conclusions of my original paper is therefore warranted.

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### Economies as an Antitrust Defense: Comment

It is true that, in the case of a merger,  $A_2 - A_1$  measures the goodness of a merger when time is not considered. When Oliver Williamson proceeds to a consideration of the value of a merger under conditions of growing demand, however, he uses the wrong comparison of cost saving as against welfare loss.

Before the merger, Williamson assumed a competitive situation ( $P_1 = AC_1$ ). Therefore, if the natural growth rate of demand lowered costs to  $AC_2$ , we should expect price to fall to  $AC_2$  and output to increase to  $Q_2$ , because a continuation of a state of vigorous competition is to be expected when demand is growing and market shares are ill defined. Therefore, the actual welfare or deadweight loss when considering  $P_2$  as opposed to  $AC_2$  is  $HFC$  which is composed of  $HED$  plus  $EFCD$ . The relevant area of deadweight loss to be considered in a comparison of merger as opposed to internal expansion is  $HFC$  as opposed to  $HED$  ( $A_1$ ).  $HED$  will persist and  $EFCD$  will fall over time as will  $BFEP_1$ .

The relevant comparison is then  $V = \int_0^T [S(t) - L(t) - L_1(t)] e^{-rt} dt$  where  $S(t)$  and  $L_1(t)$  fall over time and  $L(t)$  remains constant over time.  $S(t) = BFEP_1$  when  $t=0$ ,  $L(t) = HED$  for all  $t$  and  $L_1(t) = EFCD$  when  $t=0$ .

For  $\bar{S}/\bar{L}$  of 3, the time of indifference between merger and internal expansion would then be more than four years, for a value of two it would be

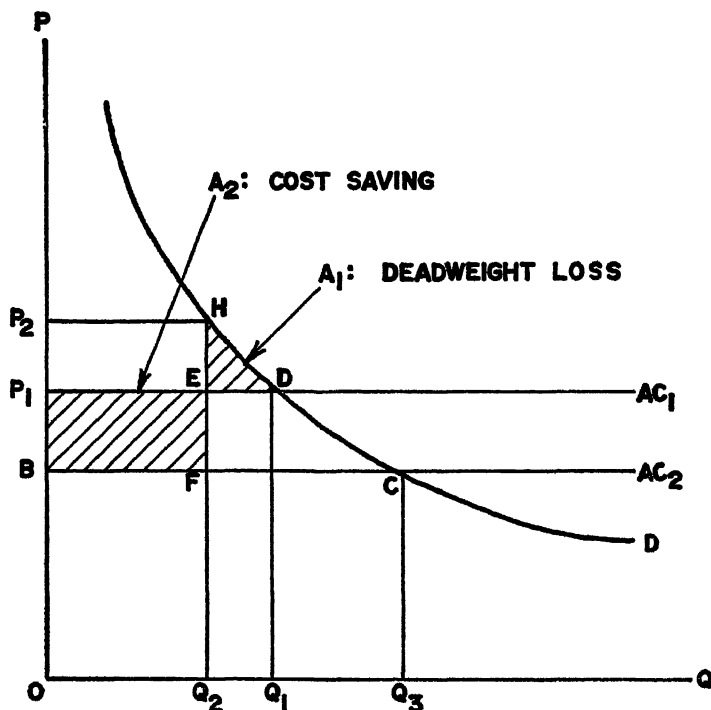


FIGURE 1

more than seven years, and for a value of 1.5 it would be more than eleven years.

PETER ROSS\*

\* The author is a graduate student at the University of Western Ontario.

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1. O. E. WILLIAMSON, "Economies as an Antitrust Defense," *Am. Econ. Rev.*, March 1968, 58, 18-36.

### Economies as an Antitrust Defense: Correction and Reply

A correction factor should be applied to expression (3) in my original paper [2, p. 22].<sup>1</sup> Among the variety of factors that can be devised,<sup>2</sup> the one

<sup>1</sup> I am indebted to F. K. Levy for calling the error to my attention. [Professor Levy withdrew his paper on the subject in favor of this correction by Professor Williamson—*Editor*.]

<sup>2</sup> One that has convenient properties if the demand curve is assumed to be linear is to multiply the second term in my expression (3) by  $1/[1-\eta(\Delta P/P_1)]$ . If, however, as would appear likely, a constant elasticity function gives a better approximation to the demand curve in the relevant region, the correction factor shown in (3') is to be preferred.

TABLE 1'—PERCENTAGE COST REDUCTIONS  $[(\Delta(AC)/(AC)) \times 100]$  SUFFICIENT TO OFFSET PERCENTAGE PRICE INCREASES  $[(\Delta P/P) \times 100]$  FOR SELECTED VALUES OF  $\eta$ .

$\eta \backslash (\Delta P/P) \times 100$	2	1	1/2
5	.26	.12	.06
10	1.05	.50	.24
20	4.40	2.00	.95
30	10.35	4.50	2.10

with the most satisfactory properties involves dividing equation (1) [2, p. 22] through by  $P_1 Q_1$ , where  $P_1 = kAC_1$ , and substituting  $\eta(\Delta P/P_1)$  for  $\Delta Q/Q_1$ . The inequality in (3) then becomes:

$$(3') \quad \frac{\Delta(AC)}{AC} - \frac{k}{2} \eta \frac{Q_1}{Q_2} \left( \frac{\Delta P}{P_1} \right)^2 > 0.$$

This is identical to my original expression but for the  $Q_1/Q_2$  that now appears in the second term. In words, the inequality shown in (3') says that if the decimal fraction reduction in average costs exceeds the square of the decimal fraction increase in price premultiplied by one-half  $k$  times the elasticity of demand times the ratio of the initial to final outputs, the allocative effect of the merger (judged in naive terms) is positive.

In consideration of this correction, the values in Table 1 need to be changed accordingly.<sup>3</sup> Again set  $k$  equal to unity (premerger market power is assumed to be negligible) and assume that demand has constant elasticity in the relevant region. Table 1' shows the corrected values that obtain under these assumptions. The changes are not substantial.<sup>4</sup> The naive model thus continues to support the following proposition: a merger which yields non-trivial real economies must produce substantial market power and result in relatively large price increases for the net allocative effects to be negative.

I should also like to clarify the argument in two other respects. First, the second-best qualification [2, pp. 23–24] has implicit in it the assumptions that the factor markets of the industry in question are competitive and that the firms involved in the merger produce strictly for final demand. For an intermediate product industry, the qualification becomes somewhat more complex [1]. Second, equation (5) [2, p. 31], which deals with the effects of changes in the rate of progressiveness as a result of a merger, assumes

<sup>3</sup> Also, of course, subsequent references in the paper that rely on the original formulation (e.g., the discussion of weighting [2, p. 27]), need similarly to be corrected. The income distribution expression [2, p. 28] becomes  $L/I = (1/2)(\Delta P/P_1)(Q_1/Q_2)\eta$ . Since the substitution of  $\eta(\Delta P/P)$  for  $\Delta Q/Q$  is appropriate only for small percentage price changes (less than 10 per cent), the values appearing in Table 1' were computed from the expression  $\Delta(AC)/AC - (1/2)(Q_1/Q_2)(\Delta P/P_1)(\Delta Q/Q_1) = 0$ .

<sup>4</sup> For elasticity 2, the corrected values exceed my original by about 10 per cent. The two sets are identical for elasticity 1. For elasticity 1/2, the corrected figures are less than the original by about 5 per cent.

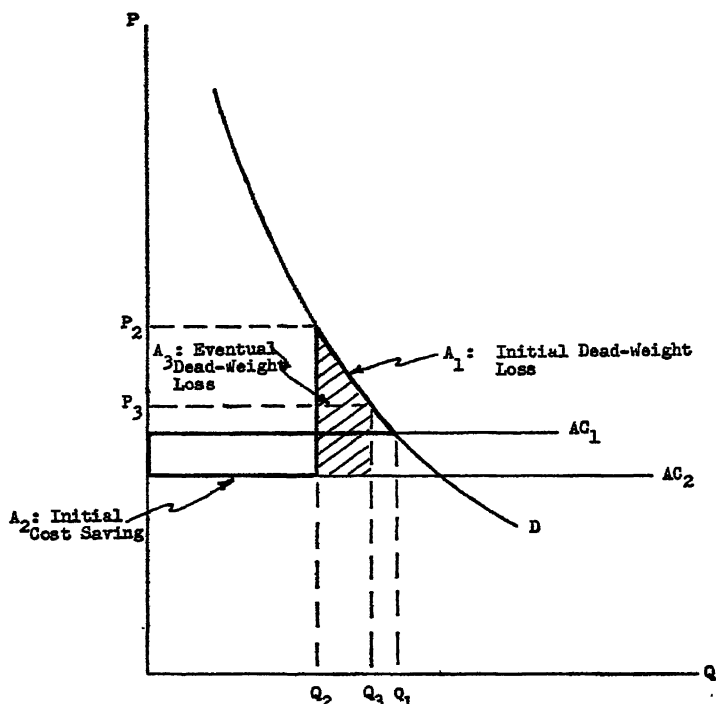


FIGURE 1

that only the yield and not the expenditures on R & D are affected by the combination. Although any expenditure difference could go either way, one would expect in general that the higher rate of progress would be associated with a higher expenditure stream, in which case the indicated allocative advantage associated with the more progressive structure would be correspondingly reduced.

Consider now the comment by Peter Ross. The issue concerns estimation of the dead-weight loss that obtains if the potential economies available through merger are realized (with a delay) by internal expansion instead. If, as Ross assumes, price falls to  $AC_2$  when the internal expansion is completed, my original estimate of the continuing (as distinguished from the immediate) dead-weight loss attributable to the merger is understated. But the essential question is this: What market power effects can reasonably be expected if the economies are realized by internal expansion? The suggestion that I advanced [2, p. 25] was that these would be a decreasing function of the rate at which market demand increases. Under Ross' formulation, the market power effects associated with internal expansion are strictly inconsequential. Implicit in my original illustrative example, by contrast, is the assumption that, although internal expansion reduces the market power effects below those that would obtain if economies were realized by merger, market power does not vanish.

TABLE 2—SWITCH-OVER VALUES ( $T'$ ) FOR SELECTED VALUES OF  $\bar{S}/\bar{L}$  AND OF THE ATTENUATION COEFFICIENT ( $\alpha$ )

$\alpha \backslash \bar{S}/\bar{L}$	1.5	2	3	6
0.0	0.0	0.0	0.0	0.0
0.3	7.2	4.7	3.0	1.5
0.7	11.1	7.1	4.6	2.7
1.0	12.0	7.9	5.1	3.0

Although an examination of special cases can be instructive, a more general analysis would involve investigating the entire range of possible internal expansion consequences. Useful for this purpose is the concept of an attenuation coefficient—which I define as  $\alpha = (P_2 - P_3)/(P_2 - AC_2)$ .  $P_2$  and  $AC_2$  are specified; the value that  $\alpha$  takes on thus depends on the post-expansion price  $P_3$ . If  $P_3 = AC_2$ , in which case  $\alpha = 1$  (which is the case considered by Ross), internal expansion results in the full attenuation of the market power effects that a merger, if permitted, would produce; no attenuation exists if  $\alpha = 0$  (since here  $P_3 = P_2$ ); partial attenuation occurs if  $\alpha$  falls in the interval  $0 < \alpha < 1$ .

For each value that  $P_3$  (and hence  $\alpha$ ) takes on, the question becomes: How soon must the internal expansion occur for the merger to have net negative allocative consequences? The relevant benefit and loss regions to be examined are those shown in Figure 1.

Again let  $S$  be the initial cost savings of the merger (the rectangle designated as  $A_2$ ) and  $L$  be the initial dead-weight loss (the triangle designated as  $A_1$ ). When the internal expansion is completed and the price  $P_3$  obtains, the dead-weight loss of the merger becomes the shaded region  $A_3$ . Let  $T'$  be the switch-over point such that, on allocative grounds, one is indifferent between going the internal expansion route or permitting the merger. Again, let the discount rate be 10 per cent. Substituting the values  $\bar{S}$ ,  $\bar{L}$ , and  $A_3$  into equation (4) [2, p. 25], the critical values of  $T'$  are those for which the discounted value of the net benefits of the merger are equal to zero. To wit:

$$(4') \quad V(T') = \int_0^{T'} (\bar{S} - \bar{L})e^{-rt} dt - \int_{T'}^{\infty} A_3 e^{-rt} dt = 0.$$

Solution values of  $T'$  in this expression, for selected values of  $\bar{S}/\bar{L}$  and  $\alpha$ , require that the magnitude of the initial price increase and the elasticity of demand be specified. Assume for this purpose that demand has unit elasticity in the relevant range and that the merger gives rise to a 10 per cent price increase, which is probably a rough upper bound. The switch-over (indifference) values that obtain for selected values of  $\bar{S}/\bar{L}$  and  $\alpha$  under these assumptions are shown in Table 2.

The lower the value of  $T'$ , the more quickly must economies be realized by internal expansion for a merger to have net negative allocative consequences. As would be expected, early internal expansion becomes more



essential as the ratio of initial cost savings to the initial dead-weight loss ( $\bar{S}/\bar{L}$ ) increases and as the attenuation coefficient ( $\alpha$ ) decreases. Roughly, the values of  $T'$  that appear on and to the right of the main diagonal are sufficiently small that one should have reasonable confidence that potential economies will be realized in the next few years for a merger to be disallowed because of its allocative consequences.<sup>5</sup>

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\* The author is professor of economics at the University of Pennsylvania. Research on this paper was supported by a grant from the National Science Foundation.

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1. L. W. MCKENZIE, "Ideal Output and the Interdependence of Firms," *Econ. Jour.*, Dec. 1951, 61, 785-803.
2. O. E. WILLIAMSON, "Economies as an Antitrust Defense: The Welfare Tradeoffs," *Am. Econ. Rev.*, March 1968, 58, p. 18-36.

<sup>5</sup> Note two things. First, this conclusion does not make allowance for any of the other possible qualifications to the naive model that appear in the original paper [2, pp. 23-32]. These also need to be considered.

Second, the solution values of  $T'$  depend on the choice of  $\Delta P/P_1$ ,  $r$ , and  $\eta$ —increasing as either  $\Delta P/P_1$  and  $\eta$  increase, decreasing as  $r$  increases. My guess is that the selected values of  $r$  and  $\eta$  are probably close, but that the choice of  $\Delta P/P_1$  tends toward an upper bound. Hence, "typical" values of  $T'$  will be lower than those shown.

#### Correction

Professor D. R. Kamerschen wishes to correct an error in his article "The Influence of Ownership and Control on Profit Rates" [*A.E.R.*, June 1968]. The sentence on page 441, lines 24-26, should read: "There is a statistically significant relationship between the profit rate and the eight-firm concentration ratio ( $X_5$ ). And the sentence on page 444, lines 15-17, should be similarly changed to read: "The simple correlation results showing a significant relationship between profits and concentration is not confirmed in the multivariate analysis."

## BOOK REVIEWS

### General Economics; Methodology

*Economics and the Public Interest.* By R. T. GILL. Pacific Palisades, Calif.: Goodyear Publishing Co., 1968. Pp. 306. \$5.95; paper, \$3.95.

*The Economic Problem.* By R. L. HEILBRONER. Englewood Cliffs, N.J.: Prentice-Hall, 1968. Pp. xx, 652. \$8.95.

The two books have the same aim: to give a thorough introduction to economic theory, as accepted at present by everybody except the uncompromising anti-Keynesians. Heilbroner, in particular, has made sure to present what any careful reader will know about prevailing economics; indeed, the book can be recommended both as a textbook and for self-study. For the same reason, some instructors may prefer Gill because he leaves them a little more to explain.

Heilbroner's book devotes considerable space to an historical introduction (the whole of Part I), the more important in the reviewer's opinion since it is exactly in economic history where the usual three-part division into economics, sociology, and political science collapses.

One defect is common to both writers as well as to the theoretical literature known to this reviewer: they essentially give a theory of the price-formation in the market, though by no means exclusively of perfect (pure) competition; they do not discuss price formation in case of production *at order*. At least a rough estimate of the significance of production at order might have been given.

To come back to Heilbroner, his warranted historical interest has occasionally caused oversimplification. To give some examples: were there no yeomen in ancient Greece, say, during the Peloponnesian war, and in Rome before 150 B.C.? For the city dweller in the Middle Ages, the citizen's personal freedom is conceded, but the substantial supply of long bow archers until about 1400 A.D. proves that the yeoman cannot have vanished before that date. More's *Utopia* can easily mislead the reader; although he shows that enclosures started in his time, he fails to inform the reader of the Tudors' successful fight of these tendencies—and even a century later Cromwell could form an army from their ranks. It is the eighteenth and not the sixteenth century which removed the yeoman from the social structure.

These are admittedly minor points. We make them because we are conscious of our own shortcomings in the field of economic history, which rightly has become a specialty with its own methodology. The high quality of Heilbroner's book is not impaired by such small errors, and though Gill's book is somewhat differently organized (micro-economics before macro-economics) it, too, can be strongly recommended as a textbook.

HANS P. NEISSER

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*New Developments in the Teaching of Economics.* Edited by KEITH G. LUMSDEN. Englewood Cliffs, N.J.: Prentice-Hall, 1967. Pp. viii, 293. \$5.95.

This collection of papers grew out of a conference "exclusively for economics teachers" conducted in the summer of 1966 by the Stanford Graduate School of Business and underwritten by the General Electric Foundation. The major thrust of the book is toward "methodology in teaching economics rather than on the content of economics courses." The emphasis in most of the papers is on the use of new techniques and equipment in teaching and on course evaluation. Like all such conference volumes, this collection contains the unevenness inherent in such an approach, but it also conveys some of the eagerness and enthusiasm of individuals who are caught up in their own academic innovations.

One of the values of this book is the willingness of many of the contributors to turn a critical eye on their own profession. At one point G. L. Bach chides his colleagues with the statement that "in planning and judging our own major activity, teaching, we are not only unscientific, we are often openly antiscientific." The authors of the papers in this volume try to remedy this discrepancy and provide empirical evidence on the effectiveness of teaching methods and teacher evaluation.

Bernard Haley begins the collection with a pleasant introduction citing the recurring, but apparently unheeded, concern of thoughtful economists with the quality and effectiveness of teaching in the profession. Changes in economic education are illustrated by the difference in the Stanford economics curriculum between 1919-20 and 1966-67. The number of courses and their titles have not changed substantially but the level of theory is much stronger in the 60s.

G. L. Bach, in the first of his two contributions, gives a review of recent efforts to improve the quality of economic education. His paper provides a good source of information on such efforts, although much of what he discusses has taken place at the level of secondary education. In his other paper, Bach discusses his experience with an evaluated experimental one-semester basic course for non-majors which he developed at Carnegie Institute of Technology. His results show how an adequate investment in planning and developing such a course can be successful in developing both student interest and analytic facilities, even though it may still be considered a difficult course. He observes that the biggest problem in the course was keeping the faculty members' attention on the agreed objectives of the course "in contrast to their following more typical behavior of lecturing happily on the niceties of economic analysis that they had recently learned on their graduate courses."

Editor Keith Lumsden provides one of the best contributions in his stimulating discussion of programmed instructional materials. Lumsden is properly critical of the lack of technological change and innovation in education. He points out that too many of us are unconcerned with our lack of efficiency in teaching. He explains the value of programmed texts in teaching economics and then follows with some empirical evidence of the results of using these materials at both the high school and college level. His results indicate that some of us may have been wasting both our and the students' time on things

which could be learned more efficiently using programmed texts. Lumsden closes with "a plea to those teaching economics to experiment." There is also a short paper by Allen Calvin which stresses the value of programmed instruction.

A provocative contribution for those who teach principles or an introductory macroeconomic theory course is the paper by Richard Attiyeh presenting a macroeconomic model for classroom use. He develops a simple simulation model for which students can be required to choose the values of the policy variables fed into the model. The values of policy variables will depend on the policy objectives chosen by the students or the instructor. Students can be quickly made to see the relevance of the choice of policy objectives as well as some of the difficulties involved in conflicting goals. The whole concept is an intelligent way of making meaningful to students both theory and policy.

In the first of his two papers on the use of TV for instructional purposes, Donald Paden cites evidence on the relative performance of sections of an introductory course using TV and a lecture, a conventional lecture system, and TV combined with the programmed materials. The results indicate a better performance from the TV sections than the non-TV sections and an even better performance from the TV plus programmed instruction than from the other TV sections. In his second paper Paden explores some of the problems in using TV to teach economics. One of the serious handicaps is the negative bias of both students and faculty. Paden also stresses the investment in time and effort that goes into the production of tapes for instructional purposes (faculty members do not get residuals).

John Due's essay on course goals and evaluation is one of the best papers in the collection. While Due modestly disclaims any expertness other than several years of teaching experience, he makes a penetrating and witty critique of the economist as a teacher. Due feels that economists have not clearly stated the goals of their courses and have only rarely made any effort to evaluate the effectiveness of their teaching. His discussion of methods and instruments of course evaluation should prove useful to those who are seriously interested in evaluation of their own basic courses. The paper ends with a delightful section on *Genus Facultatis* (covering such species as "the Young Genius," "Stationary State or Old Concrete Brains," "the Course Clutcher," etc.) in which it is all too easy to see oneself.

D. V. T. Bear presents an argument for a greater use of mathematics in the basic courses. To support his case he makes predictions of what the economics curriculum will look like in 10-20 years, when economics majors may have much the same mathematics requirements as the engineering and physics majors of today. Bear makes several telling points in support of his position: high school algebra is often more effective in conveying meaning than complex diagrams, and attempts to avoid algebra may require as much or more mathematical background than using it. However, when Bear describes his own course one has the feeling he has over-emphasized mathematics at the expense of the economics.

The contribution by Alan Thompson, a former British MP, is on teaching the economics of government, commenting on the difference between the

budget procedures in the United Kingdom and the United States. He stresses the need for new concepts in teaching but in general his paper does not contribute any.

Theodore Rodgers' and Karl Radov's papers are on the use of computer-assisted instruction (CAI). Rodgers indicates some of the promise in CAI but does not adequately discuss its limitations. Radov's paper is more pertinent for economists, particularly at the college level. A professor "is a superb teaching machine, but horribly inefficient," and CAI can greatly increase his efficiency by freeing him for instruction that can not be programmed.

The final paper in the collection is by J. C. G. Boot on the use of management games. Boot discusses two games, one that is played individually, and one team game. The role of these games in management training is clear, but Boot does little to explore the potential benefits from the wider application of these techniques in economic education.

This is a very provocative and significant collection of papers for those interested in improving the effectiveness of their own and their colleagues' teaching. Of particular merit are the contributions of Lumsden, Attiye, and Due. The true worth of this volume will show itself in the classroom.

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### Price and Allocation Theory; Related Empirical Studies

*Microeconomic Theory of the Market Mechanism: A General Equilibrium Approach.* By ROBERT E. KUENNE. New York: Macmillan; London: Collier-Macmillan, 1968. Pp. xiii, 411. \$7.95.

This 400-page book announces as its overriding purpose "to introduce a general equilibrium outlook into the structure and teaching of the intermediate microeconomic theory course" (p. vii). The author adds that "the general equilibrium approach used in the book . . . includes the integration of capital goods and money from the beginning" (p. viii). The task is well done.

The selection and organization of topics follow, for the most part, a pattern which has become fairly conventional, at least in advanced courses in microeconomics. Following an opening chapter of 32 pages on methodological considerations, there appear 96 pages (in two chapters) on the theory of the consumer, followed by 93 pages (again in two chapters) on the theory of the firm in circumstances where the firm's managers can ignore potential reactions of rival suppliers. Chapter 6, as an aside, discusses the problem of the firm when rivals' reactions cannot be ignored. The first step toward price determination and price adjustment is taken in Chapter 7, on the assumption that all prices save one under study are specified at their full equilibrium levels, while Chapter 8 describes the equilibrium of the entire system, when all prices are to be determined. The concluding chapter demonstrates that the equilibrium conditions established for the market mechanism coincide with a subset of the necessary conditions for the optimality of a centrally planned allocation. These topics certainly constitute the core of the microeconomics course, and the additional emphasis in this text on the analytical structure—at the expense of

some detail on market organization, income distribution, and like topics—appeals to this reader.

Static analysis is employed throughout. The fiction of a weekly “trading day,” during which contracts are established for all transactions to take place during the succeeding week, is adopted. Though this device offers expository convenience, it does lead one to combine wealth constraints and income constraints in a way which could not carry over directly to a continuous time formulation. That is, by imposing on changes in wealth an implicit denominator of unity (one week), this device attaches to stock changes a flow dimension, and an upper bound on the attainable rate of stock decumulation, which is wholly arbitrary. The present book falls into no errors on this count, but one might like to see the student warned that this convention can obscure some analytical issues.

The analysis is conducted almost entirely without explicit use of calculus, determinants, or the like, but instead demands of the student substantial effort in visualizing rotating pencils fastened at the origin, or derby hats sliced by sheets of metal, or trumpets placed on their bell ends and sawn through obliquely. Whether or not this makes the text more accessible, there is no loss of precision. The conditions for equilibrium, and the consequences of a perturbation of the prescribed data, are developed unusually carefully.

Within individual topics, perhaps the most apparent innovations occur in the theory of the consumer. The consumer is assumed to hold (or hold title to) all assets, including a stock of money, and to offer each week to sell the services of all assets, making allowance for his own reservation demand for these services as necessary. Saving is the result of a demand for perpetual future income, and is effected through additions to stocks of money held as an asset, or through purchase of “bonds” which act as agreements to purchase capital goods, being held only within a single week and then redeemed at the end of the week by delivery of an equivalent value in capital goods. The arguments of the utility function therefore include flows of all consumer goods, flows of all factor services, a stock of money, and a measure of the value of capital goods held. The decision of the consumer is assumed to be constrained by the single requirement that the rate of expenditure on consumer goods and asset services not exceed the rate of income plus the rate of decumulation of wealth, and this constraint of course reduces to the usual budget constraint if stock equilibrium may be assumed.

The demand for cash balances for transactions purposes is determined mechanically as proportional to intended cash outlays. The demand for money as an asset, however, is treated as a part of the demand for perpetual future income (that is, for wealth) and the consumer's portfolio thus contains money in excess of transactions needs only so long as the rate of interest does not fall below the (perfectly certain) net rate of return on capital goods. Equity is nonnegotiable in this model, entitling consumers to a share of firms' profits, but not offering an instrument for accumulation of wealth. Thus there is no market for equity.

Properties of the ordinal index representing the consumer's preferences are developed from elementary axioms. (One of the rare slips in the book occurs

in the introduction of the notion of a binary relationship at the foot of p. 46, and in the example of a violation of transitivity on p. 47.) Thereafter the conditions for equilibrium of the consumer are developed with close attention to corner conditions and goods not purchased.

From these equilibrium conditions (and on the assumption that stock equilibrium prevails, so that the wealth constraint coincides with the usual budget constraint) Chapter 3 derives the usual theorems about the consequences of perturbation in the data, including the observation that demand for real cash balances is homogeneous of degree zero in all prices.

The consumer submodel, then, reduces the intertemporal life-cycle allocation problem to a choice between various components of present consumption on the one hand, and perpetual future income, or wealth, on the other. With this device, employed already by Walras, the saving of the consumer is incorporated into the analysis in a convenient fashion, although explicit description of the way wealth enters the utility function would of course require an explicit solution to the consumer's lifetime allocation decision. In addition, the portfolio decision of the consumer is explicitly introduced, though again in rather primitive fashion. Recognition of these aspects of the consumer's decisions at an intermediate theory level seems an important forward step, particularly as a foundation to further work on dynamic analysis.

The treatment of the theory of the firm differs from standard texts less in content than in the division of the topic. When decisions may be made without regard to any response of competing suppliers, a single maximand may be treated, and tools of calculus are appropriate, whether the issue is perfect competition, monopoly, or monopolistic competition. When the existence of rivals with conflicting goals must be recognized, and their anticipated responses incorporated into the analysis, calculus tools must give way to game theory or the study of differential games, treating problems with independent decision makers simultaneously pursuing incompatible ends. This distinction does seem helpful in focussing on the analytical significance of the different market structures.

Static efficiency conditions in production are, of course, independent of the structure of the product market. Chapter 4 deals with these conditions for production of a specified output at minimum cost. Chapter 5 begins with analysis of short- and long-run output determination under pure competition, and proceeds to determination of demands for inputs. There follow 20 pages on a linear model for the firm, and 10 pages on the firm in monopolistic competition, where matters like selling costs and product differentiation receive brief attention. Though consideration of such topics is undoubtedly highly desirable, it seems questionable that much can be accomplished in the space allotted. These two sections must stand primarily as pointers to interesting directions which the student might later pursue.

What little can be said about rivalrous competition, without going into detailed analysis, is laid out, as a digression from the main theme of model-building, in Chapter 6. For the ambitious student, reference to the notion of the core of an economy might have been appropriate in passing.

The first step toward bringing the market participants together is taken in

Chapter 7, which considers the determination of the price for a single non-durable good or service, on the hypothesis that all other prices are specified at their true equilibrium values. A brief look at the standard difference-equation analysis of the stability of the adjustment process for a single price is included. Discussion of the markets for durable capital goods, bonds, and money, is held over because the simplified portfolio behavior assumed for the consumer yields no explicit demand functions for these assets.<sup>1</sup> Markets for factor services are handled in straightforward fashion, with some discussion of the peculiarities of the labor market, and a brief hint as to the investment decision and demands for capital services in an environment in which firms acquire and hold nonmalleable capital. A glimpse may be seen of the way in which a rising supply price prevents desired investment rates from becoming infinite, but the brevity of the discussion forces neglect of most of the analytical complications.

The complete model is set out in Chapter 8, where the price vector, taken as given by all participants, is determined by the requirement that all markets clear. The further conditions required for stock equilibrium and portfolio balance are enunciated, and a few comments on the markets for money as long-run asset or short-term security, and on the process of readjustment to equilibrium, conclude the model.

Chapter 9 draws the important conclusion that the competitive equilibrium is Pareto-optimal, suggesting that the market mechanism can be viewed as a computational procedure for realizing the necessary conditions for social welfare maximization (so far as allocation of resources goes, individual endowments being taken to be fixed). Closing the system, it is implied, can be accomplished (following any necessary redistribution of endowments) by selecting a price for perpetual net income, and determining saving so that the marginal increase in social welfare owing to an increase in demand for bonds is equal to this price. The determination of this price by the planning authority is left open. And these last considerations leave us, it seems, with an interesting challenge to determine how the competitively determined aggregate saving rate might, in this scheme, relate to its centrally determined analog. But that, of course, is another story altogether.

The book seems well laid out, with almost no misprints (only one, in the definition of elasticity on p. 127, might ever trouble the student). There are no exercises, and very few examples. A list of selected readings at the end of each chapter suggests sources for elaboration of some of the ideas introduced, but—perhaps because of modesty—there are few references to more technical treatment of the core analytical material.

Despite its attempt to avoid mathematical presentations, this book is neither elementary nor easy. Its prose seems sometimes to be a little strained, and the relative emphasis accorded different topics may seem to some readers to reflect a highly personal point of view. Its use as a text will demand much of both student and instructor. But the rewards would justify the effort, I

<sup>1</sup>In a full dynamic model, the role of these demand conditions is filled by auxiliary differential equations determining perfect asset prices, but these (and the corresponding capital revaluations) are of course not relevant in this static discussion.



think, and not only for the student interested in microeconomics as such. As preparation for an advanced course in macroeconomics or growth theory, the book would be hard to beat.

RODNEY DOBELL

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*Human Values and Economic Policy—A Symposium.* Edited by SIDNEY HOOK.  
New York: New York University Press, 1967. Pp. x, 268. \$6.95.

This volume comprises papers delivered at a joint symposium of philosophers and economists, and is divided into three parts. Part I contains a paper each by K. J. Arrow and P. A. Samuelson in which the former summarizes his celebrated discovery of the impossibility theorem, while the latter stresses that this theorem does not imply the impossibility of a social welfare function in Bergson's sense. The third paper in Part I is by R. B. Brandt, a philosopher, and contains criticisms of the economist's approach to the problem of "human values and economic policy." This approach usually attempts to obtain some sort of "social preference ordering" from individual preference orderings. These criticisms, and some defenses against them, are the main theme of the papers in Part II. Part III examines how the behavior of corporations affects the economist's approach to the problem of efficient resource allocation. Here we meet again the not wholly original hypothesis that tastes are not autonomous, but are affected by the social environment; unfortunately, no one has yet suggested how this hypothesis might be incorporated into a newer welfare economics. Unless that is done, the hypothesis will make no impact on the formal structure.

I turn now to Part II of the volume, which is concerned with the basis of value judgments in economics. Most of the philosophers, and some economists, are critical of the very restricted approach to value judgments—based almost entirely on the Pareto criterion—which has traditionally been adopted in economics. I think that this critical attitude is justified, and shall devote the remainder of the review to this issue (it is also considered in a provocative paper by S. S. Alexander, whose views overlap mine).

Historically, the reason for the prominence of the Pareto criterion is that it seemed to offer the only way of defining a "social improvement" which was consistent with an individualist and nonpaternalist view of "social welfare" and did not require "unscientific" and hence objectionable interpersonal comparisons. Furthermore, given appropriate additional assumptions, neat conditions for optimality—particularly in the case of competition—could be derived. Thus, the Pareto criterion seemed to be the only possible basis for a "scientific" welfare economics. Because of this, writers like J. M. Buchanan still insist that it is the only welfare criterion which economists may "legitimately" discuss (surprisingly, Buchanan's name is never mentioned here in this connection).

In the sense in which I have just discussed it, the Pareto criterion is intended to be factual and hence is without any moral significance—a point often made in this book. However, the Pareto criterion has also been regarded

as important because it was thought that the implementation of Pareto-improvements would meet with general moral approval. The philosophers and the philosophically minded economists writing in this book are quite prepared to interpret the Pareto criterion as a moral norm and seriously to consider its merits as such (e.g., papers by K. Baier and E. van den Haag). Not surprisingly they find the moral claims less than decisive.

On the whole it may be said that the philosophers adopt a more unified view than that usually to be found among economists. Thus, economists have formal models of welfare in which such terms as "an increase in welfare" are clearly defined; but when they write on policy matters in an informal way they often advocate policies on the ground that these would "increase welfare," using the term "welfare" in a sense which it is difficult to relate to that employed in the formal model. One reason for this is simply, as the editor of this volume notes, that when we "... come to consider which specific human values [are] to be taken as guides to desirable programs of economic change" (p. 246) the formal Pareto criterion is inadequate, so that other criteria of welfare must be considered. The philosophers tend to recognize this from the start and therefore do not dichotomize their treatment in the way economists are wont to do.

Criticisms of the Pareto criterion as a means of appraising practical issues of policy have abounded ever since this criterion attained prominence in economics, and many of them are restated in this volume. Yet the arguments which led to the formulation of this criterion continue to command wide adherence. Surely (so runs the argument) nobody will deny that a change which satisfies the Pareto criterion *is* a social improvement! On the other hand, if we appraise changes which do not meet the Pareto criterion, do we not enter murky waters? We then make interpersonal comparisons of utility; we may be selective as regards the preferences that ought to count; and we may even claim that something is in someone's interest, when his "revealed preference" tells us the opposite. Thus the solid anchor provided by the Pareto criterion is lost, and we are adrift amidst "purely subjective" value judgments. Hence the virtual "monopoly" (Alexander, p. 108) position of the Pareto norm.

If one takes these arguments for the Pareto norm seriously one is, by implication, denying the possibility of rational moral argument about social policy, because one is denying the possibility of appraising alternative political decisions, if none are Pareto improvements.

As Alexander points out, the economists' identification of "values" with "preferences" seems to imply an emotive theory of ethics, so that moral issues are beyond rational argument. Although philosophers invented this theory, they seem by now to have buried it. The philosophers who contributed to this volume resist the moral nihilism which is implied by the view that the only changes we may "legitimately" rank are Pareto changes. This alone would be enough to commend the book to those who may have been exposed to an excessive dose of welfare positivism.

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### Income Theory; Related Empirical Studies

*Probleme der Einkommenspolitik.* Edited by ERICH SCHNEIDER. Tuebingen: J. C. B. Mohr (Paul Siebeck), 1965. Pp. iv, 215. DM 25.

This compact volume offers a survey of the current state of incomes and profits policy in convenient form. The range of such policies is great. At present the United States cannot be said to have one at all, since occasional outbursts from the White House hardly merit that label. At the other end of the scale, the Netherlands has had a coherent incomes policy since the Second World War. Such countries as England and Italy lie between.

The survey is made up of contributions by fourteen European economists, each treating a specific aspect of the subject: the rationale of incomes policy (J. Pedersen), its impact on capital formation (P. Coulbois), inflation (E. Kueng), wages policy and income distribution (J. Vibe-Pedersen), the scope of policy (K. W. Rothschild), monetary equilibrium (P. Dieterlen), models of capital formation (B. Gleitze), and profits taxation (E. Gerelli). These functional divisions are followed by country case studies: the Netherlands (J. Pen), Britain (C. T. Saunders), Denmark (K. Laursen), Italy (G. C. Mazzocchi), and Finland (E. Toernqvist). A final essay deals with the contribution of the OECD to the development of incomes policy as an economic policy instrument of central governments (P. de Wolff).

The compilation represents the gist of a round table conference at the Institute for International Economics of the University of Kiel, intended to be the first of a series of discussions of contemporary problems in the field. Ten countries were represented in the present round table, but the reader is spared a completely polyglot volume: nine of the essays are in English; five, in German. There is a certain amount of overlap among the contributions, but it is held to tolerable limits. The general level of sophistication and thoughtfulness evidenced by the contributions is quite satisfying.

Of particular interest to economists in the United States might be the emphasis placed on the forced choice between control of wages and fluctuating exchange rates. The dilemma suggests that if the United States does not control wages it must cut the dollar loose; if it wishes to hold a firm dollar exchange rate, it must control wages. Neither alternative holds much appeal to the actual policymakers.

Another emerging problem has to do with the growing strategic importance of labor unions, which might culminate in monetary policy being controlled not by the central bank but by the labor union executive. That possibility, suggested by Cassel years ago, is still unrealized, but it does suggest the desirability of unions' developing a well-rounded economic philosophy instead of their old aphoristical insistence on "more."

This collection of essays takes its place in a growing list of studies devoted to incomes and profits policy. Schneider suggests that these essays provide a wider and deeper view of the problem than has been available up to now. A reading of the collection bears out the reasonableness of that claim.

H. OTTO

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*Patterns and Mechanics of Economic Growth—A General Theoretical Approach.* By DAVID CARNEY. Yellow Springs, Ohio: Antioch Press, 1967. Pp. xii, 155. \$5.00.

The intentions of the author of this book, as they can be divined from the problems he tries to solve, are of the best. I shall show that he apparently fails almost completely. He observes that balanced growth of the Harrod-Domar kind must be a special empirical situation, and that one may therefore conceive of three distinct rates of growth, no two of them equal. Thus, from the equation  $Y = C + I$ , one can derive the relation

$$(1) \quad \dot{Y}/Y = (C/Y)(\dot{C}/C) + (I/Y)(\dot{I}/I).$$

Writing  $r_j$ ,  $j = Y, C, I$ , for the three growth rates, one has from (1) that  $r_Y$  is a weighted average of  $r_C$  and  $r_I$ . If all three growth rates and the two weights are nonnegative, the possible relations of the  $r_j$  are evidently  $r_C > r_Y > r_I \geq 0$ ,  $r_I > r_Y > r_C \geq 0$ , and  $r_Y = r_C = r_I$ . These observations are all true and nearly trivial.

Suppose however that one noticed that the treatment of investment in this model was entirely net, and that one should include various aspects of replacement and technical improvement of equipment in the analysis. With this emendation, combined with an unbalanced growth assumption, one could derive formulae for the growth paths of net and gross investment, consumption, and income, as functions of behavioral parameters, that might be of use to macro-planners. Though this is a very limited audience, it is a real one. Indeed, the author says in the first paragraph of the Preface:

This book is an outgrowth of my thoughts on the process of economic growth and the problems confronting the macro-planner in developing countries. It is also a sequel to an article . . . in which my main interest was to derive an investment formula which incorporated depreciation, obsolescence, and technological as well as net investment. . . .

One may expect, then, a reliable derivation of formulae for growth paths as functions of parameters of consumption functions and/or savings functions, and an elaboration of gross investment formulae depending on the behavior of income, net investment, the capital stock, and various replacement policy parameters. An added bonus would be empirical application: the selection of countries that can be shown to fit some aspects of a particular pattern and a demonstration that some parameters not previously estimated might fruitfully be measured or predicted using the general model. All these things the author tries to do. In most, he doesn't succeed.

Let me list the successes. Carney correctly derives the implications of the various unbalanced-growth assumptions for the underlying marginal propensities to consume and save, for the investment accelerator, and various other such quantities. These derivations all use the formula  $Y = C + I$ , and  $Y$  must be *GNP*. This is going backwards in terms of any conventional view of what constitutes a parameter and what is a variable to be determined, but the exercise is at least correct on its own terms.

The failures begin with the first elaboration of the investment formulae.

Carney introduces the three categories of depreciation mentioned above with the formula  $R=D+0$  (where  $R$ ,  $D$ , and  $0$  are obvious mnemonics) and assumes that "technical investment,"  $M$ , equals  $0$ . Then he assumes that  $D/R$  and  $M/R$  are parameters,  $\mu$  and  $\tau$ . It is necessary to determine  $R$ . If  $K$  is the capital stock,  $R=\pi K$ . What is  $\pi$ ? Carney avers that it is always  $r^2_Y$ , but he is wrong. First, his proof assumes that in unbalanced growth the ICOR is a constant, yet he later shows that it is not. Second, the basic equation of the proof assumes that GNP and NNP grow at the same rate. This is not possible in unbalanced growth because replacement cannot be a fixed proportion of gross income. Third, even with all this going for him, the last step of the proof is to assert that an equation of the form  $(2-\mu)\pi = (1-\alpha)r^2_Y$ , where  $\alpha$  is a parameter such that  $0 < \alpha < 1$ , establishes that  $\pi = r^2_Y$ .

Turning from these false derivations to applications, we find two areas of interest. First, the "Comparative Dynamics of Growth." This chapter contains extensions of the correct derivations mentioned above, culminating in the observations that: (1) If  $r_C > r_Y > r_I$ , it is consumption that plays the dominant role in the growth pattern. (2) It is possible to go from  $r_C > r_Y > r_I$  to its inverse by passing through balanced growth. Second, we have a study of growth rates and growth paths that establishes beyond doubt that absolute growth can be fairly steady even if the proportional differences  $[Y(t+1) - Y(t)]/Y(t)$  rise and fall over time.

Finally there is a study of the consistency of actual growth rates of  $Y$ ,  $C$ ,  $I$  and "components of  $I$ " for rich and poor countries. The data are essentially observed time series, mostly for 1956-1962 in detailed "historical" studies or from published plans for African countries. Aside from the necessity for all behavior to accord with the accounting tautology in (1), the results depend on derivations of formulae that are wrong.

So some of the data don't fit. Even more remarkable is that there are no statistical procedures used for what is presumably a statistical test. For Carney, all estimates are averages and all averages are unbiased!

I conclude as I began: the book is a failure. I cannot recommend it either to students or practitioners. I must add that some of the blame rightfully falls on the editors of the Antioch Press, whose reviewing procedures seem less than perfect.

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### **Economic History; Economic Development; National Economies**

*The Cambridge Economic History of Europe*. Vol. IV: *The Economy of Expanding Europe in the Sixteenth and Seventeenth Centuries*. Edited by E. E. RICH AND C. H. WILSON. Cambridge: Cambridge University Press, 1967. Pp. xxii, 642. \$14.50.

The full series of the *Cambridge Economic History of Europe* has come into print with excruciating slowness, with one volume of the six (V, companion to the present work) still on its way. The planning for the three volumes on the

Middle Ages began in 1934, but the third volume did not appear until 1963. For the modern period, planning began in 1948. Volume VI (in two Parts) appeared in 1965. In the case of the two volumes on the sixteenth and seventeenth centuries, at least, the snail's pace has had substantial advantages; for both what we wish and what we need to know about that era have taken a sharp turn in very recent years.

History is of course rewritten by each generation, and must be, for the questions put to the past come from the historians' own and everchanging times. We economists are generally familiar with the many and proliferating studies of the industrialization that began in England in the late eighteenth century, and that spread over Europe and to North America and Japan. We have much less familiarity with the current and intensive reexamination of the preindustrial (or "early modern") period, a reexamination that especially over the past two decades has broadened and deepened in such fashion as to push toward—and perhaps require—a redefinition of the tasks of economic history; even, some say, of the tasks of historians and of social scientists generally. The economic historians of industrialization hope to shed light on the process of economic development; those who struggle with the materials of the early modern period find themselves grappling with the very roots of modern society, and they do so as, and because, the structures, institutions, and the functioning of modern society are daily called into question.

Industrialization has brought material comfort and some kind of personal freedom for a few hundred millions of us; but for the mass of people in the world, life is still Hobbesian: nasty, brutish, and short. In a world in which few any longer dare to declare "so be it," and in which rhetoric, technology, and politics combine to promise or to threaten a vastly different world, it is essential to grasp what it is that holds back beneficial and needed change; it is essential to comprehend why violence, misery, and oppression are still the lot of the world, despite—or is it because of?—the progress of recent centuries.

Everything has changed in the half millennium since Europe began to expand over the oceans; but some things have changed more than others. What has changed most is technology, man's mastery over nature; what has changed least is man's mastery over himself, and his steady inclination to master others. In the West, we like to believe we have found ways for men to live well in freedom; and some of that is doubtless to be found in our past and our present. But too much of what we call freedom is really mobility, and the mobility we have found—both social and geographic—is much like the popular education we have fostered and the goods we absorb: a grease necessary for modern industrial society, that leaves man a creature.

What is profoundly and unarguably different from the past are the quantity and scope of things; what is arguably too much the same for most people is the quality of things. Modern scope or scale, call it what you will, required the overseas expansion to bring it to being; and called into being, it served as the necessary (not, of course, the sufficient) condition for modern technology. The first steps were, as one might expect, in agriculture and in trade.

G. B. Masfield points out in his excellent article on "Crops and Livestock," that through the expansion to America, "at one stroke the potential

vegetable resources of the known world had been doubled. The dispersal of crops and livestock which followed was the most important in human history, and perhaps had the most far-reaching effects of any result of the Discoveries" (p. 276). One could quarrel with the last clause, for the other developments that accompanied or followed directly from the Discoveries—in shipping and shipbuilding, science, commercial organization, finance, new supplies of specie, the slave trade, and the necessary emergence of functioning national political units—make it impossible (as well as unnecessary) to single out "the most far-reaching effect."

But all these required and enabled a major shift in the scope of economic and political affairs, and a concomitant process of social change. What is fundamental to understanding that epoch, and thus our own, is that the institutional changes of the early modern period showed more of continuity with than of change from their medieval past, or, as C. H. Wilson puts it in his superb essay, "Trade, Society, and the State," "Much of the apparatus of economic control which came later to be associated with the economic or political ambitions of the modern state was in fact medieval in origin: the product of parochial or sectional demand or of simple xenophobia" (p. 496). And when he adds (on p. 518) that "Jealousy, ambition and common sense were then the principal springs of the policy later called mercantilism," how many would find much but the rhetoric of today's nations to add to parochialism, sectional demands, xenophobia, jealousy, ambition, and common sense as basic elements of today's policies? And should we be able to much distinguish the seventeenth from the twentieth century in that respect cut out for comment by Sir George Clark, when he remarks that "War . . . may be said to have been as much a normal state of European life as peace. . . ." (p. 514) That of course is not a new idea, as regards either century.

What seems new is a conclusion being moved toward by a rising number of the most energetic scholars of the early modern period, a conclusion that provides a steel link between the seventeenth century and the present, and between the modern state and war. The ideas of these scholars—vigorously represented by Lawrence Stone, Frederic Lane, Vicens Vives, and John Elliott—receive indirect confirmation in the present volume, and may be expected to be met more directly in the forthcoming Volume V, which will assess "the results" of the developments in science, technology, agriculture, commerce, finance, and state policy examined in Volume IV.

These ideas were succinctly noted by Lawrence Stone, when he wrote (in the *New York Review of Books*, March 3, 1966) that he and those cited above "regard the modern state as primarily a war-making machine, created and driven forward by the needs of military preparedness and aggression. It can hardly be doubted that this has been its most successful field of activity over the past four hundred years, and there is nothing in the contemporary world to suggest that any change is in prospect."

The more familiar one is with the history of the past century or so, the more outrageous such a notion might seem—but should it? As we rush through the last third of this century, having no idea of whether or how we shall survive it, it becomes increasingly absurd to view even "the century of

peace" (i.e., 1815-1915) as being peaceful for any but those who won its wars, nor to view the minimal liberal state as being but an isolated hiccup in the world's history. Historians of an earlier generation could responsibly ask chicken and egg questions concerning Protestantism and capitalism, chuckle at the imbecility of mercantilists who viewed an unfavorable balance of trade with alarm, or posit a close relationship between price changes and a social revolution. All these remain interesting issues, but the volume under review takes them up in a subdued spirit, acknowledging not only their complexity, but the affinities to be found between ourselves and our brothers under the skin of those centuries past.

Thus, Fernand Braudel, masterfully using and interpreting data worked up by Frank Spooner, simultaneously provides new support for, and grounds for doubting, the quantity theory of money, in his examination of "Prices in Europe from 1450 to 1750." Raising two, three, or four questions for everyone that he answers, Braudel never fails to relate each quantitative conclusion to essential and largely unexplored qualitative uncertainties. The reader is enormously stimulated and enlightened (and sometimes bewildered). Karl Helleiner's essay on population changes provides a sophisticated (which is to say complicated) and reflective analysis of demographic change, which supports the essay by Masefield referred to above. Charles Wilson's long labors in the policies of the new nations has made it possible for him to put forth in less than 90 pages what many books have been unable to do, and to do so, one notes with gratitude, for more than just England and France. If the result is intellectually rewarding, it is also depressing, as we see ourselves still cutting through the same jungle. J. H. Parry's essay on "Transport and Trade Routes" is a compression of what he has done well in his many books and articles. The two essays by E. L. J. Coornaert, "European Economic Institutions and the New World; the Chartered Companies," and E. E. Rich, "Colonial Settlement and Its Labour Problems," do more than synthesize the best of recent research; they both take a hard look at the institutions and patterns of expansion of those times and portray them in ways that all too sadly remind us that the impulses that led to the forms of the past are still operational, if with different forms, in our own day. What is lacking today is the time and the space in which to persist in what can most charitably be described as fundamental errors.

A. Rupert Hall concludes his comprehensive and enlightening essay on "Scientific Method and the Progress of Techniques" with the observation that the scientific inventions of the industrial revolution "were made, but they could not be understood" (p. 154). How much do we understand of the society we have made?

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*Incomes in Postwar Europe: A Study of Policies, Growth and Distribution.* By the Secretariat of the Economic Commission for Europe. New York: United Nations, 1967. Pp. xv. 433. \$8.00; paper, \$6.50.

This is the third in a series of studies prepared as supplements to the Eco-



conomic Commission for Europe's (ECE) annual economic survey. The first two considered the sources of postwar growth and appraised economic planning in Europe. The present study surveys and analyzes materials pertaining to the functional and personal distribution of income and its growth in Europe since 1950. The division of Europe into east and west is adhered to closely, and different analytic, institutional, and policy issues are discussed with reference to the two blocs. A staggering amount and diversity of statistical evidence is organized into twelve chapters and linked to ambitiously detailed discussions.

With respect to western Europe, chapters deal with the anatomy of price and income movements, patterns of wage change associated with price changes and unemployment (Phillips curves), institutions for implementing income policies, the evolution of sectoral and occupational earnings differentials, and the impact of taxes and transfers on the distribution of personal income. In eastern Europe, incomes policies are geared to the achievement of rapid growth, where they first sought to raise the proportion of income invested without incurring disequilibrium in the consumer market and then to improve the efficiency of resource allocation by more flexible reliance on the price mechanism. Chapters also present scattered east European data on occupational and sectoral earnings data, and some on the sources and size distribution of household income. A final chapter is devoted to Yugoslavia. Thus, the first half of the book is a useful and detailed treatment of postwar incomes policies in western Europe, and the second half presents much new material and many thoughtful insights on eastern Europe, although it nevertheless suffers from a problem that plagues inquiry in this field in both east and west, lack of statistics.

It has become an accepted fact, with growing documentation, that international agencies such as the ECE and OECD are severely limited in undertaking international comparative analyses of government policies and performances. Professional economists have, I believe, reluctantly learned to settle for careful descriptive accounts. But there lingers the Utopian thought that an organization like ECE, with its unique qualifications for drawing lessons for policy design from the diverse experiences of European countries, would engage in this form of comparative analysis. Indeed, the ECE's mandate to undertake supplementary analytical studies, freed from the constraints posed by the annual survey format, would appear to have been an invitation to engage in this sort of higher level consideration and evaluation of public policy.

Incomes policy, the theme of this book, poses the problem of reconciling the social objectives of personal equity, static efficiency, and rapid economic growth. With ideological differences between the economics of east and west diminishing, there promises to be insights to gain from a comparison of the success governments have had in pursuing these potentially conflicting social objectives. At the risk of misinterpreting the implications of the evidence presented in this study, I have decided to state what appear to me to be its implicit conclusions.

There are two related although separate dilemmas with which incomes policies cope. Incomes policies are frequently proposed to improve the distribution of social product among persons. What constitutes a better or more equitable distribution of income is not defined, though increasing equality appears cen-

tral. In contrast with the substantial reduction in income inequality in western Europe between prewar and postwar periods, overall inequality in the size distribution of personal incomes has not changed appreciably since the war.<sup>1</sup> Indeed, a remarkable characteristic of the period is the relative stability of pay structures and earnings differentials by sector, occupation, and skill level within western and eastern European countries despite substantial differences between countries. Nor has the tax-transfer system altered much the distribution of disposable personal income. In western Europe the incidence of progressive income taxes diminished, and the incidence of regressive turnover and social security taxes increased during the period. In eastern Europe income taxes are low, though progressive, and allied with family allowances provide strong pro-natalist incentives to parents, but public consumption, such as health and education services, probably has a more important redistributive effect than taxes and transfers. There is no firm evidence in this study that direct incomes policies have proven effective in this period in equalizing the distribution of personal income in Europe.

The second dilemma of incomes policies is difficult to evaluate: to sustain a high investment rate to foster rapid economic growth and a high employment rate without incurring an unacceptable rate of inflation. What constitutes an unacceptable rate of inflation is determined in the West by willingness and ability to devalue and by the distortions or inefficiencies attributed to inflation. Anxiety over inflation in eastern Europe is harder to understand, for with foreign trade divorced from internal prices, inflation need not affect the balance of payments. Central planners, however, may worry that inflation will create difficult-to-correct distortions in, and reduce their control over, resource allocation. Regardless of motivations, both blocs sought high rates of capital accumulation without inflation, which required dampening wage demands in order to restrain price increases. From the evidence presented in this study it is difficult to attribute to incomes policies and direct price and wage controls more than a temporary role in restraining excess short-run claims on national output. In the longer run, the distribution of income and the sustainable rate of economic growth were determined by other factors.

For example, the growth of the labor force in nonagricultural activity appears to account for much of the difference in growth rates among European countries. Structural shifts of labor from agriculture to industry after the war was a key ingredient to the rapid growth enjoyed in eastern Europe, and the recent increase in the growth of the labor force helps to explain the current upturn in Soviet and Polish growth rates. The same logic is applicable to the West, where the shift of labor out of agriculture has been only slightly less important, and international (and refugee) migration has provided an added measure of labor force elasticity in West Germany, Switzerland, and France.<sup>2</sup>

This study presents a wealth of difficult-to-collect information, poses in-

<sup>1</sup> This earlier change is documented in the Economic Commission for Europe, *1956 Economic Survey of Europe*, Geneva: United Nations, 1957, Ch. 9.

<sup>2</sup> Charles P. Kindleberger, *Europe's Postwar Growth: The Role of Labor Supply*, Cambridge, Massachusetts: Harvard University Press, 1967, and Edward F. Denison, *Why Growth Rates Differ: Postwar Experience in Nine Western Countries*, Washington, D.C.: The Brookings Institution, 1967.

numerable questions of intrinsic importance, and structures some tentative hypotheses about European developments that should now attract further analytic and comparative study.

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THE RAND CORPORATION

*Pakistan's Development: Social Goals and Private Incentives.* By GUSTAV F. PAPANÉK. Cambridge: Harvard University Press, 1967. Pp. xxii, 354. \$8.95.

This is an important book for three reasons. First, it contains a most interesting and suggestive analysis, with considerable quantitative information, of the development of industrial entrepreneurship in an underdeveloped country. Second, it is a study, with a strong point of view, of a major developing country widely regarded as a "success." Third, the book's author, Gustav Papanek, is the director of Harvard's Development Advisory Service, the economic advisors to the government of *inter alia*, Pakistan, Indonesia, Ghana, and Colombia. This book provides an important opportunity for economists to examine the point of view of the director (and of many of the staff) of this major advisory service. All economists interested in economic development will want to read this book. The major emphasis of the book is on the rationality of farmers, industrialists, and traders, and their response to economic incentives. The government of Pakistan is viewed as the successful manipulator of the incentives facing the private sector influencing the allocation of resources, the rate of growth, and the distribution of income (though not with equal success in all areas).

The book is written in a jaunty style (which sometimes clouds the analysis) and it is well organized. The first chapter contains a brief sketch of economic history in Pakistan: the effects of the Partition of the sub-continent in 1947, the stagnation of overall income growth, and the exceedingly rapid growth of manufacturing industry during the 1950s, the acceleration in economic growth, particularly in agriculture in the 1960s, the rise in investment and saving rates and the sharp increase in foreign aid that began in the late 1950s. Chapters 2 and 3 are concerned with the growth of entrepreneurship, the movement of traders to manufacturing industry, and the importance of small ethnic minority groups in the new industrial classes. These two chapters are the heart of the book and make the most significant contribution. There is considerable quantitative documentation in these chapters of the sources of entrepreneurs, the incentives to move to manufacturing, the concentration of wealth, etc.

Chapters 4 and 5 deal with the government sector, including the civil service, the role government played in directing industrial investment, and particularly the nature and operation of the direct and indirect control mechanisms used to influence the allocation of resources. The discussion of controls is, unfortunately, not as precise and quantitative as it could have been in view of other recent studies of economic controls in Pakistan. Chapter 6 describes the development of agriculture and draws heavily on the work of W. P. Falcon and C. H. Gotsch. The bulk of attention is given to the reasons for the accel-

eration of growth after 1958, and relatively little attention is paid to the stagnation of agriculture in the 1950s. The stress is laid on the rationality of the peasants and their responsiveness to profitable opportunities and economic incentives. Chapter 7 contains a discussion of the sources and development of saving in the economy, and is appropriately titled "Squeezing the Peasant." A substantial portion of the chapter is devoted to building up saving estimates from a variety of sources using what Papanek admits are shaky data and a considerable amount of guesswork. These will be of much greater interest to the Pakistan specialist than to the general reader. A caveat is in order regarding the distribution of saving by source, since other recent estimates on the sources of saving are inconsistent with Papanek's. Another major proposition of the book, in this chapter, is that the principal limit on the volume of saving and investment in Pakistan was the availability of foreign exchange. While this should fit nicely into the two-gap scheme of Chenery and associates, there is no reference to that literature. In Chapter 8, titled "The Social Utility of Greed," Papanek provides a summing up of his argument and point of view and proposes a system of indirect controls to achieve the various goals of Pakistan's development efforts, as he sees them.

The basic line of argument in the book runs as follows. Pakistan had virtually no domestic saving, no industrial capacity, and no industrial entrepreneurship at the time of Partition. During the 1950s, the government used a stringent set of direct controls which greatly increased the profitability of manufacturing industry and turned the terms of trade sharply against agriculture. Because the trading community was composed of rational entrepreneurs, they recognized the greater profitability of manufacturing and moved into industrial entrepreneurship. Because of direct controls on imports of consumer goods, particularly luxuries, the high profits reaped by the manufacturing entrepreneurs were reinvested in manufacturing industry, and saving rates rose as industrial output grew. Just as the opportunities for "easy" import substitution in the consumer goods industries were running out in the late 1950s, the government changed its policy away from direct controls toward indirect controls, and it improved incentives for investing in other types of manufacturing. As a result, the rapid rate of industrial growth continued. The rapid industrial growth in the late 1950s moved the terms of trade back in favor of agriculture (or less in favor of industry), and this improvement in prices, along with changing policies on purchased inputs and on improved technology in agriculture resulted in a sharp acceleration in the rate of agricultural output growth as rational farmers responded to profitable investment opportunities. As the government shifted its emphasis from direct to indirect controls, not only was investment reallocated to more essential industries, but also efficiency in existing industries was greatly improved.

Unfortunately, there is relatively little attention given to indications of the level of efficiency. Indeed, there is no reference in the text or the bibliography to a controversial article by R. Soligo and J. J. Stern which seriously challenged the efficiency with which Pakistan's industries were operating. They went so far as to suggest that a number of major industries operated at a point where value added, when evaluated at world rather than domestic

prices, was *negative*, because of the price distortions of the tariff structure. This article appeared in 1965, and was commented upon in the *Pakistan Development Review* by Papanek who viewed their results with great skepticism. In view of the fact that there is so little evidence of efficiency, and in view of the known distortions in the domestic price system, it is difficult to see how Papanek can be so sanguine about the results of measured industrial growth in Pakistan.

A basic problem with the book is a confusion between the rational behavior of entrepreneurs and farmers in the face of changing incentives and the efficient allocation of resources from the point of view of society as a whole. Papanek recognizes, of course, that these two things need not coincide; that is, that what is profitable from the individual's point of view need not be profitable from society's point of view. However, the argument tends to neglect the problem of efficient resource allocation, and concentrate on the ability of the system to produce more physical output, regardless of the costs. The confusion is perhaps best indicated by the use of sentences such as the following: "Private, decentralized decisions are efficient in economic terms only if they are responsive to economic incentives" (p. 229). The fact that output grew at an extremely rapid rate tends to overshadow the problem of the high costs in real terms of producing that output. In discussing the growth of efficiency, Papanek states "the entrepreneurs devoted very little attention to the problem of technical inefficiency. Although technicians might deplore this neglect, it was sensible economics" (p. 62). Again, this may be sensible for the individual but not for the society. While Papanek notes at many points in the manuscript that there were exceedingly high profits, that prices were out of line with international opportunity costs, or that inefficiency was rampant in some parts of industry, these caveats tend to be overlooked in his enthusiasm for the rapid growth of manufacturing output. An alternative way of viewing the same facts that Papanek finds would be to say that if one distorts the price system enough, one can induce private entrepreneurs to produce almost anything. My own feeling is that Papanek greatly understates the inefficiencies that existed in the incentive system given to manufacturing entrepreneurs, as I have explained at some length elsewhere.

The second major difficulty with the emphasis in the book is a glossing-over at times of the differences between the performance in the 1950s and the performance in the 1960s. In agriculture, for example, the dismal performance in the 1950s tends to be overlooked and the 1960s are emphasized. One statement, for example, tells us "if one reviews the discussion thus far, it is clear that the use of price incentives, sensible policies, and efficient government action achieved a respectable rate of growth in agricultural production" (p. 179). This appears at the beginning of a subsection on agriculture, and there is no mention made of the time period. This can *only* apply to the 1960s, though the dates are mentioned only here and there in the text. In the final chapter, Papanek talks about "the success of its [Pakistan's] development." He states that "the pattern which has developed was successful because some Pakistanis have behaved like economic men, responding to economic incentives" (p. 226). In fact, GNP per capita increased 23 per cent in 15 years, or

slightly over one per cent per year. This is hardly what one could call successful economic development, though it may well have been greater than what was expected in 1947. The glowing reports are all about either industrial growth in the 1950s which was indeed spectacular (if terribly inefficient), or the spurt of total growth including agriculture in the 1960s, which was accompanied by a substantial increase in the inflow of foreign aid. It is my opinion that Papanek has greatly underestimated the importance of foreign aid in the 1960s through most of the discussion of the book. The discussion on page 153 of the decontrol of food grain prices, for example, emphasizes that price controls were removed and that the government established minimum and maximum buying and selling prices for wheat. The stabilization of prices is hailed as a success of the decontrol policy though we are told almost parenthetically of a substantial increase in PL480 wheat supplies which provided the resources to insure successful decontrol.

One could go on at length to debate the merits and demerits of various ways of measuring efficiency, or efficient economic growth. The point here is that in my opinion Papanek has paid too little attention to this problem and been too much impressed with the rapid growth of physical output, regardless of opportunity cost, particularly in manufacturing industry. In a sense, Papanek has taken a position in the "growth vs. efficiency" argument in the development literature. The questions are not faced explicitly, since the view is that inefficiency and growth can be merged into efficiency and growth by suitable policies. It is my hope that this book will be widely read and widely discussed, as it represents an important contribution to the literature on economic development.

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*Asian Drama: An Inquiry into the Poverty of Nations.* By GUNNAR MYRDAL. 3 vols. New York: Twentieth Century Fund (hardcover ed.); Pantheon Books (paper ed.), 1968. Pp. xxx, 705; xvi, 824; xvii, 754. \$25; paper, \$8.50.

This book, ten years in the writing, has long been awaited. Its appearance at last proves it to be well worth waiting for. Gunnar Myrdal, for the ideas expressed in his previous work, the positions he has held, and activities he has initiated, is certainly one of the world's leading and most provocative social scientists. This book, within its three volumes, has both the breadth of vision and the provocative insights for which the author is famous. Its reception has reflected both the seriousness of the effort and the reputation of the author—a front page review in the *New York Times*, selection by a national book club, and perhaps more important, wide discussion of it in the Asian countries themselves. It is not just one book, but three—one on politics, one on economic substance, and one on methodology. Although it contains extensive material on many countries, much of the work is based on Indian material and reflects the author's long visit to India.

The book begins with a statement of the problem, a lengthy discussion of the author's own values and purposes, and a statement of methodology. A

major theme is the need for a broader analysis of political and social change, by which the process of economic development is largely determined, and within which that process works itself out. The author considers that previous studies and models of economic growth have failed to consider the cumulative circular character of the entire development process, in which changes in one sphere react upon and influence changes elsewhere. While he recognizes the desirability and value of model building, he believes that with the data available at this time, the construction of mathematical models of development that abstract from political and social variables in underdeveloped countries to focus on a single economic variable, such as investment, grossly distorts our understanding of economic development in Asia, and yields misleading policy conclusions. Instead Myrdal advocates and uses an institutional approach, relying on description, careful conceptual analysis, traditional economic tools, and an interweaving based on "intuitive political judgments" (p. 1812) to come up with politically and socially relevant economic judgments and recommendations.

After this methodological introduction the book alternates between primarily political and primarily economic sections, with stress upon their interaction. There is first a long description of the political systems of the specific countries in the area and the present state of their economies. This is followed by a very good section on the ideology and goals of democratic planning, including a discussion of the political problems of control and corruption. Finally the author enters on the more narrow conventional economic problems of growth, focussing upon the key concepts of "employment" and "unemployment" in the Asian countries. He uses this as his approach to the problems and policies of agricultural development and industrialization. The formal text itself concludes with an analysis of the human element in growth, centering on the question of population growth and education policy. In fact the lengthy discussion of education policy could be a case study of his method of analysis with his criticism of the more or less conventional (even if recent) human capital approach and his own suggestions for policy. There is no general conclusion. Instead the third volume is completed by a large number of appendices on specific issues which were simply mentioned in the text itself without much support (such as the treatment of climate) or which required a more detailed or theoretical analysis. Appendix 1 contains an amusing discussion of development by terminology. Appendices 2 and 3, in effect, present a theory of development and of planning and a criticism of economic models, while Appendices 4, 5 and 8 present a more theoretical discussion of planning and the relation of prices (including "accounting prices") and controls to planning.

The split personality of Myrdal between his broad, even radical, framework and his pragmatic, quite limited policy suggestions is striking. This may reflect the book's lengthy period of preparation with changes in Myrdal's own thought over time; even more it probably reflects the difference between what Myrdal would like and what he thinks possible. A major theme is that the condition of "underdevelopment" is a total condition pervading the entire society. For a sustained movement toward modernization major changes are required not only in the economy but in the political and social structures, in-

cluding the fundamental attitudes of the people toward each other and toward work itself. Without such basic changes the drive toward modernization will flounder. With such changes there could be a cumulative interaction between the changes in political systems, changes in policies, and modernization of the society, including improvements in economic well-being. (This is of course quite similar to his earlier theory of "cumulative causation" which was developed in his small book *Economic Theory and Under-developed Regions*.) Arising from his view of whole societies is his underlying criticism of the "softness" of these underdeveloped societies, with "softness" defined as a lack of the discipline required to carry out the necessary radical programs. The evidence of softness is the gap between the ambitious statements of leaders and the economic plans of governments, and the actual actions taken by governments to transform the social order so that sustained economic development and modernization can occur. Many other observers have remarked on this gap. For Myrdal the reason for the "softness" of these societies lies on the one hand in the power of traditionally dominant or ruling groups in society, whether based on economic fact such as land ownership, or on a social organization such as the caste system; and, on the other hand, in the acquiescence of those on the lower rungs of the social system, which arises out of poverty and ignorance. Without radical changes in this existing structure of power and control, modernization and economic development will prove difficult, if not impossible. The author himself seems to favor governments that are "democratic," and he appears to be against communist or military dictatorships on both moral and pragmatic grounds. Almost as a "cry from the heart," near the very end of the book, Myrdal seems to urge as his political solution that "not only India, but the other South Asian Countries as well, have need of another Gandhi—or rather a great number of them—who would sway the upper classes and would walk the country roads and inspire the people in their villages" (p. 1824).

But in his specific policy recommendations, Myrdal is far more diffident. In fact his recommendations do not differ widely from those made by many other economists. This may be because he realizes that, in fact, there is not going to be a radical transformation of the societies in many of these countries.

First he lays stress upon the desirability of planning. But desirable planning is not the publication of over-ambitious Five Year Plans which may or may not be adhered to, and which are either abandoned or simply checked against accomplishments at the end of the period. Rather by planning is meant a rational and flexible approach to the total problems of society. The plans should include goals and priorities, carefully interwoven into a system of projects, policies and institutional changes to achieve those goals in the desired priority—and they should be prepared on a basis that permits an annual reexamination of goals and accomplishments, and a revision on the basis of such review. He also stresses that plans are not purely economic documents; they are basically political documents including not only economic goals but the policies required to achieve those goals.

Second, he stresses the main problem of employment. One of the best sections of the book is his detailed criticism of the application of western con-



cepts of employment and unemployment to Asia. In the light of this, and recognizing the major role of agriculture in the development of Asia, he emphasizes the need to raise agricultural output and per capita and per acre productivity in agriculture on a first priority basis. The policy analysis begins with lengthy critique of existing systems of land tenure and examines various land reform proposals. It concludes with a statement of the political difficulties of land reform and advocates steps to move agriculture increasingly toward a capitalistic system of land ownership, which would rely primarily upon price incentives for the existing land owners and penalties for those owners who do not use their land. His main concession to the problems of land tenure is to advocate giving landless peasants a small plot of land not so much for the direct economic benefits but for the social results. It would contribute to breaking down traditional inequalities and attitudes toward work that center about land ownership.

While he recognizes the longer-run need for industrialization he is very critical of the arguments for "heavy" industry for its own sake. He scathingly attacks the entire network of discretionary control policies, grossly overvalued exchange rates, and price policies which have led in many countries to uneconomic industries, exorbitant profits, over-protected home markets and minimal exports, while encouraging corruption and concentration of economic power. He strongly favors using the price system to the extent possible as a tool within the context of planning to achieve a desired allocation of resources, rather than the discretionary and arbitrary controls used so often as a substitute.

Myrdal's final discussion of quality of population is not only an analysis of the problems of education but is an application of his method and approach to this particular subject. He criticizes much of the recent theory of human capital and education investment; his suggestions for population and education policy, developed within his broad framework of institutional analysis, are of a limited and pragmatic character.

What criticism can be offered either of the methodology or of the policy proposals? Myrdal is highly critical of the use of western models or concepts for the problems of Asia. His criticism of capital-output models is especially pointed, on the ground that they ignore the whole social and political context within which development takes place. I have mentioned his criticisms of the human capital model and of the concepts of unemployment; he offers a similar criticism of the application of concepts of savings and consumption to the countries of Asia. Some of these criticisms have been made before; some have not; all are worth making. However, in his stress on the need for more institutional analysis, it is worth pointing out that he himself uses traditional economic concepts centering about the market and the price system as a basis for many of his own policy suggestions. These more traditional tools have been neglected until recently in the recommending of policies to the underdeveloped countries, in favor of the more complex models. A more important criticism of Myrdal's ideas is that the notions of "softness" and "discipline" which are central to his thinking are themselves derived from a western moral context. Myrdal especially underplays one major political factor in his analysis—that

is that many of the countries still are not strongly unified and that regional interests (apart from traditional social and economic interests) make it difficult to adopt and carry through a unified national policy. It therefore frequently becomes necessary to compromise—and both the goals and the policies to achieve them become far more complex and more difficult to carry out or to achieve. This is not because of “softness,” which implies a moral weakness, but because of political complexities which are not peculiar to Asia.

More specifically I think his analysis leads to a gloomier prognosis for the region and India than justified. Myrdal underestimates both the possibilities of increasing exports by the developing countries and the possibilities of increases in farm output with new technologies, especially with the new varieties of seed in conjunction with fertilizer and water supply and appropriate price policies. He overestimates the discouraging effects of the land tenure system and the caste system on output. (This may reflect the fact that some of these technological breakthroughs have only begun to have their effects since the book went to press in 1966.) It is to be hoped that this undue pessimism backed by the prestige of the author, does not lend unintended support to those in the developed countries eager to reduce aid to Asia.

I should in conclusion make several literary points. The book is too long; it is in fact boring in certain sections—especially the lengthy political section in the first volume—and it could have used further editing. Finally, it faces at least some of the difficulties that arise if a book takes 10 years to write during which new material becomes available and the author's mind changes. It would have had a greater impact upon economic thought if it had appeared in 1963, since by now some of the specific criticisms made and arguments presented have been made by other writers (for example Hla Myint and W. A. Lewis in their recent books on economic development and planning).

But with these caveats it is a massive book by a major social scientist and represents, both in its philosophy, its methodology and its economic substance, a major contribution to the entire area of development studies—a field in which during the last ten years there have been few such efforts. The book cannot be neglected by any social scientist working in the field, and it should have a major and beneficial impact upon thinking of laymen and policy makers in both the developed and underdeveloped countries.

As a final comment, this impact would be greater if a shorter and cheaper version could be published, since the prices of \$8.50 for the paperback version and \$25 for hardcover are simply too expensive for all but a few people in Asia.

GEORGE ROSEN

*Asian Development Bank*

*Overhead Capital—A Study in Development Economics.* By A. J. YOUNGSON.  
Chicago: Aldine Publishing Co.; Edinburgh: Edinburgh University Press,  
1967. Pp. viii, 192. \$6.75.

This study has two broad purposes. First, the author attempts to provide a meaningful and workable definition of overhead capital, a concept both vague and elusive and yet one which is increasingly recognized as of fundamental

importance in the development process. Second, he wishes to offer practical insights and information as to how this concept can best be employed to aid the developing nations in the formidable tasks confronting them, especially with respect to the role that government should play in investment in overhead capital.

Professor Youngson's book is organized into six chapters, of which Chapter 2, "In Search of a Definition," and Chapter 3, "Categories of Overhead Capital," constitute the essential core of the study. Most comments in this review are directed toward these two chapters.

In the opening chapter, entitled "The Growth of Public Investment," the author draws largely upon the experience of the United States, Great Britain, and Australia to show that there has been an international tendency in the developed nations for the share of government in capital formation to rise, a trend which cannot be explained by any single cause. Changes in technology and economic organization, as well as a growing recognition that the power of the state when properly used can contribute to the economic welfare and freedom of the individual were the most important reasons for the persistent expansion of the public sector in the developed countries. With respect to newly developing nations, Youngson is uncertain about the existence of a similar long-term trend, but he does assert that in the majority of such countries the contemporary situation is that an even larger share of investment is being undertaken by the government than is true for the advanced countries. The reason for this is their explicit and implicit belief that development of overhead capital is important, and that a large share of investment in capital of this kind must be undertaken by government. This brings the author to the key question of his study: what is the nature and importance of overhead capital?

Although the concept of overhead capital came into existence in the late 1940s, efforts to define it with any precision have been largely unsuccessful. Essentially, the error made by H. W. Singer, Ragnar Nurkse, and others who sought meaning for this elusive concept was to try to define overhead capital in terms of *particular* classes of goods. The question "what is overhead capital?" is, in the judgment of the author, a nonsense question but *not* a nonsense concept! The reason for this lies in the fact that overhead capital is not a *set of things* but a *set of properties*. Only when this point is recognized is it possible to talk meaningfully about this concept. Capital instruments of great variety and scope may possess none, some, or all of the properties which constitute the essence of overhead capital.

But what are these properties? In Youngson's view they are two. Capital may be regarded as overhead capital to the extent that (1) it is a source of external economies and (2) it has to be provided in large units, ahead of demand. Capital expenditure which involves either of these two properties should be regarded as the creation of overhead capital, irrespective if it is privately or publicly financed. Further, it is the existence of these effects which give rise to the necessity for either public investment or subsidy, primarily because private investment in response to the profit motive frequently tends to be less than socially ideal with respect to both these important properties. Overhead capital, in the opinion of the author, involves even more than this

because he sees these properties in some sense as a kind of catalyst necessary to innovation, which is the real key to economic development. Overhead capital turns out to be a concept which is in no sense operational; rather, its value lies in the fact that it directs attention to the kind of problems which are most germane to the development process. The most important of these concern the principle by which resources are to be allocated to projects that yield outputs which cannot be measured quantitatively or which are productive of external effects which cannot be accurately foreseen.

In Chapter 3 on "Categories of Overhead Capital" Youngson attempts to relate four broad categories of investment expenditure important to the developing nation to both the foregoing principle and the properties which provide the criteria for determination of whether or not a capital asset should be considered as overhead capital. These categories of investment expenditure, which are frequently referred to in the literature of economics as overhead capital, are: transport, irrigation and power, education, and housing. The crucial issues are, first, to what extent are investment expenditures in these categories overhead capital and as such provide an essential basis for economic development, and, two, to what extent is it necessary that these investments be by public bodies rather than private capital.

In seeking to resolve these issues Youngson looks to both the historical experiences of the advanced countries mentioned earlier and more recent experience in some of the less developed nations of today. Transport, which nearly everyone agrees plays a key role in economic development, does not have to be provided in excessively large units well ahead of demand, although it obviously meets the criterion of being an important source of external economies. The author also argues that the case for public provision of transport is based more upon the need for control of monopoly than upon the inability of the private investor to respond to the needs of the economy for transport facilities. With respect to investment in irrigation and power, he asserts that there is not a clear case for regarding the public provision of power essential on the grounds of external economies, primarily because there is no difficulty in charging the consumer of power appropriate prices and there is no strong evidence that offering power at prices below cost will necessarily stimulate innovation, particularly with respect to new combinations of resources. The case for regarding power as a form of overhead capital because of the necessity to provide for it ahead of demand is stronger, but by no means so overpowering that it must be publicly provided. Much the same reasoning applies to irrigation projects, although in most instances the scale of the individual project must be the determining factor as to whether or not it is best supplied by government. In his discussion of both transport and power and of irrigation, the author stresses that the "lumpiness of capital" argument does not necessarily apply and thus require investment significantly ahead of demand.

Education clearly represents the category of investment which accords most fully with his criteria for overhead capital. Not only is education a key source of external economies and the kind of activity which must be provided in advance of demand, but it is also the kind of activity, particularly when research is included, which offers the best hope of stimulating innovation, which the

author sees as the key role for overhead capital. Because the fruits of education appear only over long periods of time, its provision must necessarily be largely a public rather than a private matter. Housing, in the judgment of the author, does not fit particularly well into his definition of overhead capital, even though house building often accounts for a significant portion of total investment. The reason is that a house does not provide external economies to a significant degree, and because the units of investment are small, they do not have to be created well ahead of demand.

The last three chapters in the book are concerned with some of the special problems of the developing countries with respect to overhead capital—especially those resulting from the serious obstacles the developing countries encounter because of physical and climatic shortcomings—the broader repercussions that overhead capital may have on the economy of a country, and, finally, the need for relatively nonspectacular “facilitating” investments, many of which involve little more than the provision of information and instruction in simple techniques. This portion of the book is less satisfactory than the first three chapters, partly because it is less analytical and more descriptive. Since the book is advertised as “practical,” this section would probably prove to be most disappointing to the planner in an underdeveloped nation looking for ways and means to apply the concept of overhead capital to immediate problems.

WALLACE C. PETERSON

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*Manufacturing Problems in India: The Cummins Diesel Experience.* By JACK BARANSON. Syracuse: Syracuse University Press, 1967. Pp. xix, 146. \$5.95.

Contrary to the impression given by the title, this is not a mere description of operating difficulties encountered in India. It is a far reaching analysis, amply supported by relevant evidence, of the difficulties inherent in the autarchic industrialization policies pursued by India and other less developed countries. In a crisp introduction, Harry Johnson rightly concludes that “Dr. Baranson shows by concrete example that the policy of development by industrialization directed at the national market and implemented by import-substitution policies . . . has been based on a mythology of industry quite unrelated to the reality of modern industrial organization.” This mythology has substituted the “infant economy” argument for the more limited “infant industry” concept and “overlooks, ignores, or denies” the logic of scale economies and of intra- and interfirm specialization and division of labor.

Baranson’s effort is a fine example of theoretical insights and detailed empirical investigation, backed by a good grasp of the relevant production processes. The focus is on the largely unsuccessful effort to achieve economical production of U.S. Cummins Diesel engines in India. Although this was initiated by a successful U.S. firm and a well-established Indian manufacturer of less sophisticated Diesel engines, and despite the cheapness of Indian labor, Indian production costs were 3.5 to 4.1 times U.S. costs; the 1966 devaluation reduced these ratios by 20 per cent.

Several factors contributed to this result. The scale of the Indian plant was

extremely small and even then only 25 per cent of the projected demand materialized. Import restrictions, reflecting in part unrealistic estimates of the possibilities of substituting domestic inputs, aggravated the problems of high costs and low quality. These were unrealistic because of the narrow range of Indian industrial capabilities, including the lack of an auxiliary small-scale industry as in Japan, and the poor quality of the locally processed materials. In contrast to comparable firms in industrialized countries, the Indian plant had to make up for the absence of technical knowhow among parts suppliers. The divergent styles of management and unequal endowment of technical capabilities also hampered technical and engineering coordination between the U.S. and Indian plant authorities including the efforts to adapt equipment and production processes to local supply conditions.

Sensibly, the study calls for an altered and more selective emphasis on industrialization along lines which emphasize comparative advantage. National and foreign aid priorities which aim at developing technically feasible ranges of production are advanced as at least as important as expenditures on physical and human capital.

The discussion on the role of multinational corporations is, however, somewhat inconclusive. The obvious superiority of technical talent and expertise of these firms is not in question. The issue rather is their motivation to pioneer in adapting product design, manufacturing processes, etc., to the special conditions of the developing countries. This is noted by Baranson himself and has been more thoroughly discussed earlier (*AER*, May 1966, pp. 249-83). Very revealing in this sense is the contrasting economic behavior of Indian and U.S. managements as regards profitability (paradoxically it is the Indian firm which places less emphasis on immediate returns), detailed planning in the context of product and factor market uncertainties (the Indians emphasize "shirt-sleeve" operations while the Americans emphasize meticulous advance planning), downgrading product "trade mark" (opposed by the U.S. firm), etc. Baranson's stress on the international corporation must thus be read in the context of the economic policies favored by him.

There is no question that more liberal national economic policies and public expenditures can accelerate the flow of technology from developed to developing countries and its adaptation to feasible ranges of production within the framework of international business collaboration.

SUBBIAH KANNAPPAN

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*Democracy and Economic Change in India.* By GEORGE ROSEN. Berkeley and Los Angeles: University of California Press, 1967. Pp. vii, 340. Paper, \$2.25. Originally published in 1966 by RAND Corporation.

The author has undertaken a very ambitious and important task of analyzing the effects of development planning in India for its first decade (1951-61) from both the political and economic points of view. While the disaster of the Third Five Year Plan (1961-66) is recounted and the Postscript carries the story through the backlash of the elections of 1967, it is the relative success of the first decade which is the basis of Mr. Rosen's work.

Parts I and II provide the reader who is unfamiliar with India with a social and political sketch of the situation at the time of independence in 1947. Part III describes political change in India since independence, the changes in composition of the Congress Party, the growth of splinter movements, the formation of new parties, the growth of the bureaucracy under the late Prime Minister Nehru, and in recent years the great increase of the power of the state parties and governments at the expense of the Center. When Rosen finished his work in 1965 he was optimistic that for a decade or more development could continue without this shift of power being an overriding obstacle; however, in his postscript of 1967 following the elections that year, he felt that the events had "made more obvious the difficulties of carrying out economic policies in the face of the growing powers of the states, and the ideological conflicts within Congress, and throughout the country" (p. 286).

Part IV contains five chapters describing and analyzing the first two Five Year Plans. Rosen begins with an examination of the ideology of the intellectuals who started drafting plans in the late 1930s to produce a socialist state in India. However, it would appear that in fact Rosen devotes too little space to the implications of the model used for the Second Five Year Plan and its consequent influence on the Third Five Year Plan. These two plans reflected the fascination of the leadership with building a great heavy industry public sector, the use of direct controls, the suppression of the price system as an allocator, and the failure to understand the important role of agriculture in economic development. While much of Rosen's criticism in later chapters is devoted to the bureaucracy and its stifling controls, to the distrust and resentment of market prices, and to the fantastically complex controls on food grains, he does not criticize their theoretical bases—the general conception of planning as expressed in the Second Five Year Plan, drafted by P. C. Mahalanobis. Rosen mentions a number of times that an objective of the Second and Third Plans was to move resources out of agriculture (pp. 137, 139, 150, 163, 165, etc.), yet he does not indicate that the conception of the model itself upon which policy was based was mistaken on this point. Until Indian agriculture could produce an adequate marketable surplus, failure in this sector would surely eventually choke down overall growth. Especially was this true when PL 480 food grains were used to hold down food grain prices, thus diminishing incentives for the peasants. And as long as PL 480 food grains were available, why should high-caste men, interested mostly in their new public sector heavy industry toys, divert their attention to the plow? Rosen does not neglect a discussion of agriculture. He devotes a section of Chapter 11 in Part V to it. While he points out the failure to provide proper incentives to adopt new inputs, the role of agriculture in a model of self-sustaining growth is not discussed and priorities for agriculture are not mentioned. From the point of view of this reviewer, giving agriculture a subordinate role was one of the major weaknesses of the Second and Third Plans. Resources cannot be diverted from agriculture until there is an adequate marketable surplus; this will not occur until superior inputs are adopted in agriculture. That it can be done in India has been proved by the Ford Foundation's Intensive Agriculture District Program, not mentioned by Rosen.

The rural and urban as well as caste and class gains and losses of the first ten years of planning are analyzed by Rosen. This analysis is followed by Part V which concerns future economic and political trends. Part IV concludes that while some economic improvement occurred in the rural areas there was no significant sectoral change within the Indian economy; those groups benefiting most have been "land owning peasants, who are often also members of the local dominant castes . . ." (p. 176). They are the ones who have the political connections to get the favors. Among urban groups Rosen concluded that in the first decade those who gained most were the high-income members of the middle class in the private sector and the organized factory workers. Those losing relatively appear to have been the high government personnel, the lower middle class, and the unorganized and unskilled. Lowest castes, both urban and rural, appear to have gained relatively.

Part VI covers U.S. policy and Part VII contains the Postscript. In Part VI Rosen argues for the United States playing a more active role in influencing Indian plans and implementation of policies on development. He advocates using instruments of aid and trade to stimulate policies it deems desirable. Failure to do this he thinks would lead to a waste of the U.S. contribution and jeopardize the success of the entire development program in India. However, when he wrote his Postscript, following the severe weakening of the Congress Party in the Elections of 1967, he was much less optimistic that U.S. policy toward India could have any significant influence in plans and their implementation. He concludes that the internal Indian political situation in coming years will be more sensitive and even less stable than in the past; that therefore the United States would be unsuccessful in applying pressure, and in fact that what pressure has already been applied in agricultural and financial policies might have weakened the Congress government. Finally, with a weakening of the popularity of aid within the United States and the trend of political events in India which may strengthen the more ideological elements, Rosen advocates placing much greater emphasis upon the trade element in the total "trade and aid" program. He is pessimistic that the United States can influence Indian policies to any great extent, except through "technical persuasion and advice."

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*Le Développement du Capitalisme en Côte d'Ivoire.* By SAMIR AMIN. Paris: Editions de Minuit, 1967. Pp. 330. F 33.

The importance of this first book devoted to the entire Ivory Coast economy is in no small measure due to the extraordinary performance of the country in recent years. According to the estimates of the author, the average annual rate of growth of Gross Domestic Product in constant prices accelerated from 7 or 8 per cent for the period 1950-60 to 11 or 12 per cent during the years 1960-65. Even if one accepts, instead, the official estimate for 1960-65 of 8 per cent (there are no official figures for 1950-60), this is an impressive growth record. At the same time gross investment as a percentage of GDP rose from 15 per cent to 19 per cent, resulting, in part, from a rapidly growing



government budget surplus on current account. Furthermore, the Ivory Coast, since 1950, has benefited from a sizeable balance of trade surplus which has increased both absolutely and as a percentage of domestic product. Characterizing the economy during these years were immigration from other African countries which reached one-quarter of the total population in 1965, heavy investment in infrastructure by the French during the 1950s, and a rapid growth of private foreign capital flowing into industry since independence in 1960. Amin's purpose, then, is to examine this "miracle ivoirien," its causes, and the prospects for its continuation.

In his study Amin is handicapped by the usual dirt and poor quality of data, especially for the period prior to independence. To overcome this problem he has diligently and at times ingeniously constructed a series of estimates for the years 1950 and 1965 (and in some cases 1960) purporting to show the growth and structural changes of population, production, consumption, foreign trade, both public and private investment, and the balance of payments. In many cases these estimates are the first of their kind for the Ivory Coast, but, unfortunately, future efforts to improve on them are going to be handicapped by the author's failure always to indicate clearly his sources and methods of estimation. Furthermore, the main argument based on Amin's analysis of these figures would be more forcefully presented if the text were not cluttered with a detailed discussion of the derivation of his tables, and this material were confined to the statistical appendix.

The conclusions which the author draws are quite critical. In the first place he does not believe that the problem of modernizing agriculture for food production has yet been faced, with the result that imports of rice, wheat, and meat have risen markedly in recent years. Amin fails to recognize, however, that the government, very concerned with this problem, has been engaged for several years in a serious program to make the Ivory Coast self-sufficient in rice.

The author also criticizes the policy which has favored the expansion of industries producing consumer goods previously imported. In Amin's view, these are industries which appear profitable to private investors now but the expansion of which is limited by the small size of the Ivoirian market. The author suggests that industrial development should be more integrated and should include basic industries producing intermediate products and capital goods in the context of a regional West African development program. Yet as desirable as this would be, it is difficult to see how Ivoirian planners can be expected to proceed on the assumption that the differences and jealousies which have separated these nations in the past are going to disappear quickly.

Finally, Amin is concerned about the heavy dependence of the Ivoirian economy on export markets for a few primary products (principally coffee, cocoa, wood, and bananas) and on private foreign capital which has dominated the development of its industries and is responsible for the repatriation of profits tending to offset the favorable balance of trade. But Amin's alternative of inward-directed growth in a country of 4 million inhabitants and low per capita income would appear to me much less promising than the government policy currently being pursued: keeping the economy open to foreign

commerce and investment while strengthening its foreign exchange position and increasing its revenues for general development and the exploitation of its rich agricultural environment and heritage of agricultural research conducted over a period of many years.

J. DIRCK STRYKER

*New Haven, Connecticut*

*Regional Economics: A Study in the Economic Structure, Stability, and Growth of Regions.* By HUGH O. NOURSE. New York: McGraw-Hill, 1968. Pp. viii, 247. \$8.95.

It seems reasonable to speculate that this latest edition in McGraw-Hill's Economics Handbook Series heralds the beginning of a new curriculum trend. Perhaps most undergraduate and all graduate students of economics will soon be introduced to the principles of spatial economics.

A recognition of the effect of space is essential to much of economic theory. Further, many private enterprise and public policy issues are "place related" and must be approached within the context of specific rural or urban places. Spatial analysis is essential in dealing realistically with economic problems of demand, supply, cost, location, competition, markets, income and growth; and with such public policy issues as depressed areas, underdeveloped countries, urban ghettos, pockets of poverty, population growth and shifts, air and water pollution, recreation planning, and defense mobilization.

Nourse explains briefly, usually with laudable simplicity and clarity, the relevant economic theory, then applies the theory to various spatial problems. His first two chapters present concise statements of the scope and method of regional economics, and of the theory of plant location. The graphic illustrations in this section are especially good. Part I includes the theory of plant location, city locations and sizes, trading areas, industrial location patterns, geographic price variations, agricultural, industrial, commercial and residential land use, and spatial equilibrium. Part II explains the principles and the techniques of analyzing regional structure, activity and growth. The plant location theory discussion is somewhat limited in scope, and there is no effective recognition given the fact that basic economic theory might well be advanced by including spatial concepts.

Nourse has not succeeded in synthesizing the diverse elements of regional economics. This is not surprising. It is difficult to integrate the principles of plant location with the spatial ordering of cities, for example. Perhaps the best that can be done is to play hopscotch among the various segments of the discipline. However, it is unfortunate that as the reader moves from one subject area to another in this book he does not gain an integrated view and, in fact, even finds abrupt style changes which tend to emphasize and magnify the discontinuity between subject areas. In some sections the usually high standards of clarity drop noticeably, especially in the discussion of systems of cities in Chapters 3 and 9.

In a book designed for a broad audience including students and noneconomists, precision in the use of theory and terminology is exceedingly important. In the following instances this book falls below the required standard:

1. On page 81 the word "demand" is used when "sales," or "quantities demanded" should have been used.

2. A duopoly model is used to explain the location of two different plants at different distances from the market; then the book states (p. 96) "Nevertheless, the principles of the competitive situation are depicted by the diagram." If by "competitive situation" is meant something akin to pure competition this statement is not true.

3. On page 97 the expansion paths in figure 5-3 do not join the points of tangency between the relevant isocost and isoquant curves.

4. On page 140 Nourse attempts to justify the convention of handling business investment in fixed capital as expenditures for final rather than intermediate goods, saying that plant and equipment "are not part of the final product" of the goods produced. Actually the fixed capital is embodied in the output; the procedure used is required for statistical convenience, not conceptual accuracy.

5. The regional income model (pp. 158-60) implicitly assumes equality between outputs produced and money incomes received within the region. The unreality of this assumption at the regional level should merit explanation.

6. On page 159 this book states "Once resources are fully employed . . . increased product and income could come about (only) by increases in population via natural growth or migration, by increases in capital equipment, and by new finds in natural resources." The assumptions of constant technology, skills, labor participation rates, etc., are not stated.

7. On page 193 demand is erroneously stated as a function of supply: "A decline in the profitability of region as a location for a particular good causes a downward shift in the demand for the production of the good from the particular region." Reduced profitability would tend to reduce supply, raise prices and reduce sales from the region, but would not shift the demand.

This list of criticisms should not obscure the fact that this is a valuable book. It provides a good organizational framework and generally excellent summary explanations of the major segments of regional economics. Each section consists largely of a condensation and some clarification and synthesis of selected works by major contributors to the theory.

The approach is more eclectic than comprehensive and more aggregative than synthesised. However, some synthesis is achieved. And, as suggested previously, it is probably true that the melting pot of regional economics is not yet hot enough to fuse the diverse inputs.

This book is the best available source of highlights of regional economics for the economist who wants to familiarize himself with recent developments in the field and to see extensions and applications of economic theory to spatial problems. Also it will serve as a valuable text for students at various levels; the level of the course can be adjusted by varying the use of the source materials cited in the book. This book deserves the attention of the profession. It will help to make more regional economists, and more economists "regional."

ELBERT V. BOWDEN

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### Statistical Methods; Econometrics; Social Accounting

*Model Building in the Human Sciences.* Edited by H. O. A. WOLD. Monaco: Union Européenne d'Éditions, 1966. Pp. xii, 321. F 51.

This volume contains the proceedings of the Third Monaco Conference on Human Sciences, held in May 1964. The conference, organized by Herman Wold, examined various aspects of model building in the social sciences. Participants included distinguished representatives of the fields of political science, psychology, operations research, sociology, statistics, and economics. The volume contains thirteen papers along with summaries of the round-table discussions which followed each session.

To begin with the most familiar territory, we find several reports on the construction of empirical econometric models. P. J. Verdoorn and E. J. Post write on the impact, interim, and equilibrium multipliers implied by one of the recent Dutch Central Planning Bureau models, and on its forecasting record. C. A. van den Beld and P. de Wolff present an exercise in medium-term macroeconomic projections, again for the Netherlands.

In an important paper, L. R. Klein records his experience with constructing a U.S. model of modest size. The informal review of alternative structural estimation methods which introduces the paper will be useful for those engaged in implementing these econometric techniques. It comments on principal components, recursivity, nonlinearities, and ill-conditioning (= near-singularity) of moment matrices. A major portion of Klein's paper is devoted to the presentation of alternative estimates for an updated version of the Klein-Goldberger model. Included are estimates obtained by the full-information maximum-likelihood procedure. It is very instructive to learn of the modifications in economic hypotheses and statistical assumptions which were imposed to make the computations feasible. For a 16-equation specification, the full-information computation failed to converge, and it was necessary to truncate the system to secure estimates by this method. At the time of the Conference, at least, Klein's 11-equation variant was the largest system of any kind for which full-information estimates had been produced. It seems clear that despite its attractions from the point of view of statistical inference and despite the rapid advances in computer technology, full-information maximum-likelihood estimation cannot be viewed as a standard econometric procedure. As Klein sums up the situation, "It is a very delicate tool and very complicated."

Two more papers deal with specifics of economic model building, albeit not with empirical estimates. K. Porwit of the Polish Planning Commission writes on the nature and logic of long-term planning in Poland. He attempts to formalize the decision-making procedure actually in use in terms of programming models. In one version, the maximand is private consumption, with targets for public consumption and for investment being taken as given; in another version, private consumption is added to the list of given targets, and the minimand is labor input. The presentation is verbal, nontechnical, sophisticated, and price-conscious. A. Prékopa of the Hungarian Academy of Sci-

ences spells out a mathematical inventory model in which the objective is to avoid, with a prespecified probability, exhaustion of stocks.

Readers of this journal may well be most interested in the articles by non-economists which offer a look at formal model construction in the other social sciences. Patrick Suppes reports on models of learning applied to response-reinforcement experiments. A simple linear scheme is squeezed for predictions of conditional probabilities. One objective is to test normative propositions on teaching methods, with experimental evidence drawn from mathematics and foreign language training. James S. Coleman is concerned with the estimation of transition probabilities for dichotomous variables, where the transition probabilities are functions of other observable variables. He includes a discussion of the possibility of distinguishing systematic change from errors in measurement (a problem familiar to economists since the work of Milton Friedman), which is given in more detail in his *Models of Change and Response Uncertainty* (Englewood Cliffs, 1964).

Enders Robinson offers a rambling discussion of adaptive control systems, which contains some ideas on the introduction of learning mechanisms within nonhuman control systems. His main substantive illustration is a 15-page feasibility study of a medical diagnosis procedure: the use of computerized microscopes to replace human microscopists who examine blood slides for evidence of disease. Peter Whittle in a short note drawn from animal ecology points up the richness of nonlinear models. The observed time paths of the sizes of the populations of rabbits and their parasites seem very complex. And yet a pair of simple nonlinear differential equations appears to account for the observations. Whittle's discussion of multiple equilibria and stability conditions will strike a familiar chord with economic theorists. He even provides a turnpike-type result—one resists the temptation to call it a rabbit-track theorem—"Of all possible equilibria, that one is valid (i.e., stable) which maximizes total growth."

As befits a conference organized by Professor Wold, the Monaco group devoted considerable attention to methodological foundations and basic principles of scientific model building. In an expository essay entitled "Crossroads of probability theory, statistics, and theory of knowledge," Wold himself discusses single- and multi-equation models with an emphasis on problems raised by nonexperimental data, stochastic elements, and interdependence. The ground covered is much the same as in his "Forecasting by the chain principle" in *Econometric Model Building* (Amsterdam, 1964). Another expository essay, by Edmond Malinvaud, provides a concise and elegant sketch of the guidelines which underlie the stochastic specification of econometric models. It also evoked a reaction from Suppes, which is reported as follows: "I have been amazed by the way M. Malinvaud randomizes his models. Are not there any other methods of randomizing a model?" Suppes' remark will be cryptic to economists since Malinvaud's treatment is that conventional in econometrics. Unfortunately no clarification appears in the round-table discussion summary reported here.

In a rather more ambitious pair of papers, Malinvaud and Wold focus on the question of causality. Malinvaud offers an interesting attempt to axiomatize

tize the concept of causality by means of directed graphs. Wold ranges widely over various concepts of causality which appear in the scientific and philosophical literature and attempts to develop a more satisfactory formulation. Apart from the fact that it omits the second of the three steps, his approach calls to mind the homiletic maxim: "First tell them what you're going to tell them, then tell them, and then tell them what you told them." To my mind in any event, the most fruitful analysis of this subject remains that of Herbert Simon in *Models of Man* (New York, 1957).

While the present volume is marred by numerous typographical errors and awkward English translation, it does cover a range of topics of interest to economists who are concerned with the development of quantitative techniques in the other social sciences. One area which promises to gain rapid prominence was unfortunately not covered at the Monaco Conference. This is "path analysis" which has very recently been introduced into sociology. The method which originated with the geneticist Sewall Wright in 1918 (and which he had applied to a supply-demand model for hogs by 1934!) turns out to be a special case of the standard econometric approach to estimation of parameters in structural equation models. A good introduction can be found in O. D. Duncan, "Path analysis: sociological examples," *American Journal of Sociology*, July 1966.

ARTHUR S. GOLDBERGER

*University of Wisconsin and University of Essex*

*The Distribution of National Income.* Proceedings of a Conference held by the International Economic Association at Palermo, September, 1965. Edited by JEAN MARCHAL AND BERNARD DUCROS. New York: St. Martin's Press; London: MacMillan, 1968. Pp. xxx, 734. \$19.00.

This volume contains the papers and discussion from the Palermo Conference on income distribution held in September of 1964 under the sponsorship of the International Economic Association. Forty-two participants from seventeen countries met to read and discuss twenty-six papers. The participants who will be most familiar to English-speaking readers were Alchian, Bronfenbrenner, Haley, Pasinetti, Patinkin, Phelps Brown, Rasmussen, Reder, E. A. G. Robinson, Schneider, and Solow. Hearsay has it that a fine time was had by all.

The spirit shrinks at the prospect of writing a critical review of such an enormous compendium of papers. Fortunately, the book is in large measure self-reviewing, since each paper is discussed by one or more of the participants and the authors in many cases react to the criticism. Therefore, I shall confine this review to an outline of the volume's contents and a brief characterization of the material contained in each of its sections.

Part I contains six papers covering trends in income distribution in advanced capitalist countries (U.S., France, West Germany, U.K., Belgium, and Japan). The principal emphasis is on the functional distribution, and as might be expected, the papers attempt to synthesize and interpret existing data rather than present new data.

Part II contains five papers covering the principles of income distribution in

three socialist countries (U.S.S.R., Czechoslovakia, and Hungary). These papers by socialist economists are somewhat disappointing in that they place primary emphasis on the principles guiding distributional policy rather than the consequences of the policies. To be told that "The principles and methods of the distribution of the national income in the U.S.S.R. are consistent with the socialist system of social organization," is comforting, but it gives very little insight into the quantitative aspects of either functional or personal income distribution.

Part III, which consists of four papers on income distribution in the underdeveloped countries, contains two papers which are largely devoted to the question of what classifications of income are most appropriate to the analysis of development. The other two papers attempt to synthesize what data are available on underdeveloped countries concerning the functional distribution of income.

Part IV consists of seven papers on distributional theory. To the general reader this will probably be the most interesting section, especially because of the papers by Solow on functional distribution and Reder on personal distribution.

The volume closes with four papers on government and distribution. Two concern income policies in the U.K. and France, and the others concern related matters.

It should be evident from this summary of the conference's program that it had no sharply focused theme. The principal controversy in functional distribution theory is whether the distribution is basically determined by the savings-investment interaction (the Kaldorian theory) or by factor supplies (what Solow in his contribution calls the Good Old Theory). Although several of the papers focused on this issue, it is unfortunate that this theme did not dominate the conference. A greater degree of unity in subject matter need not have reduced the empirical content of the conference nor need it have detracted from the broad international coverage of the papers. It would, however, have made the proceedings volume more useful.

This is not a book which many will want to read from cover to cover. Since the authorship is so cosmopolitan, no one reader is likely to react with interest to the style or approach of every author, even if he is interested in the subject matter of every essay. It would seem, nonetheless, that there is at least something here for everybody who is at all interested in income distribution.

W. H. LOCKE ANDERSON

*University of Michigan*

*The Wealth of the Nation: The National Balance Sheet of the United Kingdom, 1957-1961.* By JACK REVELL, WITH G. HOCKLEY AND J. MOYLE. New York: Cambridge University Press, 1967. Pp. xvi, 484. \$18.50.

In the early years of national income work, the individual scholars who were developing concepts and estimates were frequently as interested in national wealth as in income. But with the appearance of J. M. Keynes' *General Theory* and the impetus it gave to official estimates of national income and product, prepared on a regular basis, the emphasis shifted largely to the devel-

opment of flow, rather than stock, estimates. After World War II, most nations of the world developed income and product accounts, but the national balance sheets and wealth estimates were neglected. Jack Revell attributes this neglect to the Keynesian influence.

In recent years, there has been a recrudescence of interest in balance sheet statistics. The broadening of work on the production function and economic growth has increased the demand for real tangible asset estimates; developments in the theory of demand to include the structure of asset holdings, real and financial, and their relationship to income flows, have given new urgency to the need for complete balance sheet data, by sector.

Economic statisticians in a growing number of countries have moved in to fill the gap, although thus far it has largely been an effort by individual scholars; almost nowhere have official economic accounts been elaborated to include balance sheets, although the development of capital accounts—saving-investment and flow-of-funds, by sector—point in that direction. In the United States, the chief pioneer has been Raymond Goldsmith, of Yale University and the National Bureau of Economic Research. As a result of his initiative, the present reviewer and others produced the report *Measuring the Nation's Wealth* (Vol. 29 in the N.B.E.R. series, *Studies in Income and Wealth*) designed to stimulate and help guide official work in improving basic data and preparing balance sheet and wealth estimates integrated with the basic income and capital accounts.

In the United Kingdom, Jack Revell has performed a service similar to that performed by Goldsmith in the United States. In the book reviewed here, he has pieced together annual sector and national balance sheets for the United Kingdom for a five-year period ending in 1961, describes his sources and methods, and presents the results of some preliminary analysis, including comparison with the United States.

Part A of Revell's work describes the conceptual framework behind his balance sheets for the United Kingdom; summarizes the statistical sources and methods used; and describes the structure of the United Kingdom balance sheet, comparing selected structural aspects of the United Kingdom with the United States.

Part B describes the bases of the balance sheet for the personal sector in some detail, and analyzes its structure. Part C covers the other five major sectors, and various subsectors, which he distinguishes. Part D discusses the problems confronted, and solutions devised, in estimating physical assets—land, and reproducibles at depreciated replacement cost. Part E covers financial claims. There are about 100 pages of tabular materials.

The basic concepts and structures used by Revell are quite similar to those developed by Goldsmith, to whom he refers extensively. In some instances, his departures are of interest; for example, on the right-hand side of the combined national balance sheet, he terms the residual obtained by subtracting liabilities from assets "Equity," which is further divided between "Share Capital" and "Net Worth."

In his analysis, he points out the significantly higher financial interrelations ratio for the United Kingdom than prevails in the United States, and tries to



explain this and other structural contrasts. In a particularly interesting section, he analyzes the effects of inflationary trends on balance sheet structure. One wishes he had been able to devote a larger portion of his time to analysis.

The bulk of his book, which discusses sources and methods, will be of little interest to others than specialists in national economic accounting. The amount of detail he and his collaborators were able to assemble is amazing. His work has certainly accomplished its purpose of demonstrating "the practical possibility of constructing national balance sheets regularly for this country" (p. xiii), as well as pointing up data weaknesses which should be overcome when balance sheets are eventually integrated with the official national income accounts.

That day will be hastened by the proposed revision of the United Nations standard system of national accounts, to be published next year, which structures the flow accounts so that balance sheets can be added on a consistent basis. The analytical usefulness of economic accounts will be materially enhanced by this development, for which pioneers such as Goldsmith and Revell will deserve a good measure of credit.

JOHN W. KENDRICK

*The George Washington University*

*An Econometric Model of Canada under the Fluctuating Exchange Rate.* By LAWRENCE H. OFFICER. Harvard Econometric Studies 130. Cambridge: Harvard University Press, 1968. Pp. x, 319. \$7.50.

The construction of econometric models of the Canadian economy got off to a flying start after World War II with the development of an annual model within the federal government under the direction, initially, of Lawrence R. Klein and, later, of T. M. Brown. Despite this strong start, research in this area lost its momentum until recently. Even now the only operational model within the government is an annual model developed by Sydney May almost a decade ago in a progression from the original Klein-Brown model.<sup>1</sup> In recent years research in this area has again begun to flourish both within the government—particularly at the Bank of Canada—and at universities. L. H. Officer's model of the Canadian economy represents a milestone in this resurgence. At the moment it is the only quarterly Canadian model of its size (108 equations) available in published form.

The substance of the book consists of a "formulation of the model, estimation of its parameters, [and] deduction of implicit impacts." All of these tasks are directly related to the central purpose of explaining the spot foreign exchange rate during the period when Canada adhered to a free foreign exchange rate system. After a brief introduction, the 50 estimated stochastic

<sup>1</sup> Published by Sydney May, in "Dynamic Multipliers and Their Use for Fiscal Decision-Making," Appendix C, *Conference on Stabilization Policies*, convened by The Economic Council of Canada at The University of Western Ontario, Aug. 30-Sept. 1, 1965, Ottawa 1966. For an earlier model in this series, see T. M. Brown, "A Forecast Determination of National Product, Employment, and Price Level in Canada, from an Econometric Model," *Models of Income Determination*, N.B.E.R. Studies in Income and Wealth, Vol. 28, Princeton 1964, pp. 59-96.

equations included in the model are set out, along with their underlying rationale, in Chapter II. In Chapter III the 55 identities and 3 semi-identities are presented together with a summary of the 217 variables used in the model. Chapter IV presents impact multipliers showing the first-round impact on all current endogenous variables of changes in exogenous variables associated with fiscal policy, monetary policy, debt management policy, exchange fund policy, housing policy, and foreign aid policy. The study concludes with three appendices and an index of variables. The book does not include the excellent tabulations of data, together with explanatory notes, which have gained some private circulation and which are included in the original dissertation that provides the basis of the book.

Officer relies basically on ordinary least squares and two-stage least squares to estimate his 50 stochastic equations. In order to overcome the prevalence of serial correlation associated with quarterly estimates he employs auto-regressive techniques in applying both methods. While his methods of estimation are conventional, his application of these methods is exceptional, and not a little awesome, for a model of this size: each equation is estimated using up to a total of six variants of the two basic procedures and selecting one of these estimates as the "best" estimate, judged largely on the basis of the absence of auto-correlation in the error terms. (Only the "best" estimates are presented in the book; the estimates derived using alternative methods are given in the dissertation.)

For one person to build as large a model as Officer has built requires not only considerable technical skill but also an exceptional range of theoretical and institutional knowledge, combined with a sure instinct for the selection of variables and relationships. I question whether Officer's hand has always been as deft in the specification of his model as it might have been. Consider, for example, his business investment equations which necessarily play a key role in a model designed to assess the effects of changes in monetary, fiscal, and debt management policies on the balance of payments and the exchange rate. Investment in both nonresidential construction and machinery and equipment is made a function of: corporate liquidity (internally generated funds) lagged two quarters; noncorporate liquidity lagged two quarters; excess cash reserves lagged two quarters ( $R$ ); and a six-quarter moving average of the rate of change in activity, as a proportion of the level of activity, all lagged two quarters ( $A$ ). These variables apparently are intended to reflect an amalgam of the "Charles River" liquidity theory of investment, the acceleration theory of investment, and an availability-of-credit theory of investment.  $R$  is not a satisfactory index of credit availability, given Canada's institutional framework; it is questionable whether  $A$  adequately reflects capital stock adjustments in responses to changes in output and capacity; and if one is going to assign importance to liquidity as a determinant of investment, it is evident that in Canada one should allow not only for the supply of domestic liquidity but also for the supply and/or price of foreign funds. One could go on in this vein questioning the specification of other equations as well: e.g., the business inventory equation and the labor market equations. Little is to be gained, however, by speculating on the superiority of one specification over another. The point

to be emphasized is that before anyone can confidently hope to improve very much on the specification of the wide range of relationships that Officer includes in his model, more detailed research on each sector of the Canadian economy is required.

Another aspect of the specification problem that leaves one in doubt relates to Officer's specification of lags. Discrete lags are assumed in most cases and the length of the lag is chosen intuitively rather than empirically. Out of a total of 217 variables, 46 are lagged either one or two quarters. No use is made of distributed lag relationships which have gained currency in recent years. The particular lag specifications that Officer assumes determine the dynamic properties of his model and the significance of the estimated impact multipliers. Consider again the investment equation and its response to an exogenous change in government spending in any period. The model assumes this will have no effect via the accelerator for two quarters and thereafter it takes six additional quarters before the effect of the initial change in government expenditure has been fully picked up. This not only means that the economy reacts very sluggishly but also that the estimated impact effect is necessarily very small. A better estimate of the impact effect might be provided by collapsing the first two rounds of expenditure, embracing the two-period lag. (Another feature of this specification of the accelerator is that, although it is slow to pick up the effect of an exogenous change in spending, once this effect has been picked up it persists and its cumulative effect is very large.)

Having estimated his model, Officer makes little use of it to elucidate the theoretical and policy questions that arise from Canada's experience with a free rate system. This is a disappointing feature of the book. Investigation of these issues may not have been among the author's objectives, even though the title of the book suggests that it was. And although there are limits to what can be expected from one book, it seems too bad that, having built his model, Officer did not wheel it into action on these questions. Not only might he have enhanced our understanding on these questions considerably but also he would have had an opportunity to test the answers provided by his model against those that have been provided without the benefit of a formal econometric model (e.g., P. Wonnacott) and those that have been provided employing much smaller and simpler models (e.g., R. R. Rhomberg).<sup>2</sup>

Even if Canada had not adopted a fixed rate system in 1962, thereby altering at least some of the estimated relationships, one could expect Officer's model to become dated in time and to be replaced by others now being developed. Nevertheless, Officer has done an impressive piece of work that will provide a useful starting point for some years to come for anyone embarking on the construction of a quarterly econometric model of the Canadian economy. He has set a high standard against which other model builders in Canada can usefully pace themselves. Throughout he displays superior technical competence along with a wide range of theoretical and institutional knowledge. In addition, he has done a superb job of presenting difficult material. And al-

<sup>2</sup> Paul Wonnacott, *The Canadian Dollar, 1948-1962*, Toronto 1965; Rudolf R. Rhomberg, "A Model of the Canadian Economy Under Fixed And Fluctuating Exchange Rates," *Jour. Pol. Econ.*, February, 1964. 72, pp. 1-31.

though Officer himself does not take advantage of his model for the purpose, he has provided an important empirical device which will facilitate further research on Canada's experience with a free exchange rate system.

GRANT L. REUBER

*University of Western Ontario*

*Adaptive Processes in Economic Systems.* By ROY E. MURPHY, JR. New York: Academic Press, 1965. Pp. xvi, 209.

In so much of economic theory, perfect knowledge of relevant parameters seems such an inevitable assumption that often it merely goes-without-saying. That so little of significance has challenged the facile acceptance of this assumption is no doubt due largely to the presumption that economics doesn't provide the tools for construction of a tenable alternative. Nevertheless, there is nothing new in casual proposals that economics be revitalized through selective borrowing from other disciplines; the meaningful incorporation of well-developed concepts of a foreign discipline into the body of economic theory is no mean task. The moderate success that Professor Murphy achieves in characterizing the informational aspects of economic behavior in terms of the thermodynamic concept of entropy makes his innovations worthy of further exploration.

Murphy begins by outlining a broad framework of discrete sequential decision-making processes in which decision makers must act, without reference to utility functions, on the basis of their objectives, convictions, and store of information. He proposes that all adaptive processes (i.e., those governed by information flows) are mixtures of two extreme types: one in which the environmental characteristics are deterministic but initially unknown to the decision maker, the other in which the environmental characteristics are stochastic as well as initially unknown. Thus the adaptive process in its most general form has a dual nature: the decision maker must learn both the shape of his environmental parameters as well as the *probable* effects of each possible action. Each action works in conjunction with whatever vagaries the environment may display to produce a transformation of state, at which point a new decision and action are necessary. Although decisions are assumed to be deterministically reached, given the individual's objectives and store of knowledge and belief, the resulting state is generally not deterministic. Given that all decisions are based on whatever degree of certainty the decision maker may have vis-à-vis his environment, Murphy is able to evaluate the effects of varying informational parameters on the decision-making process. He proceeds to construct several investment models in which the implications of uncertainty can be appraised in mathematical detail. The crucial role of imperfect knowledge in investment theory enables him to elucidate on his conceptualization of entropy as a measure of uncertainty.

In a "well-behaved" stochastic environment, a decision maker begins with a subjective probability function based on a conviction vector. Subsequent information flows cause him to modify his historical information vector, and thus to keep revising his subjective probability function until it approaches that of the actual environment. In terms of entropy, subjective entropy de-

creases over time and approaches the actual entropy, the magnitude of which is determined from the environmental probability distribution; the entropy of a fully deterministic environment is zero. The relevant concept of time here is that of entropy time, i.e., time measured only in terms of the number of changes of state. Clock-time is irrelevant, since in a stationary state, no new information can be transmitted and no new decisions are made.

One need not feel overly apprehensive about the theoretical tenability of Murphy's entropy approach. He makes no claim of conceptual validity; his purpose is rather to suggest a concept which, grounded in noneconomic phenomena, nevertheless merits consideration that it might be developed in a manner pursuant to the goals of economic study. The author's manner of exposition is fluent and concise, but often careless; definitions are flexible and are treated rather casually. That the entropy of an adaptive system decreases while that of a physical system increases is a paradox the explanation of which (Ch. 5) is sketchy and confusing; references to entropy shift between the two connotations (e.g., see p. 5). Once the author's concepts have been given a mathematical form, the development of his models is straightforward and compact; he provides only an elementary discussion of the implications of each of the models. The entire work is quite unrigorous, and the emphasis is on plausibility rather than on structural validity. However, one must concede that the vast amount of material covered precludes a rigorous initial treatment; furthermore, the lack of rigor enables the author to maintain an interesting pedagogic style and to hold well to any particular train of thought. That his notation is reasonably workable is to be commended.

MARIS GAILITIS

*Purdue University*

*Principles of Econometrics.* By KONG CHU. Scranton, Pa.: International Textbook Co., 1968. Pp. xii, 138. \$6.50.

In the days of lengthening econometrics treatises, a small text for the beginning student holds out the hope of a clear, easily accessible and concisely presented overview of the basic elements of the field. Professor Chu attempts to meet this need in some 130 pages written for the introductory undergraduate or business school student.

The first two chapters provide a short review of probability and statistics, and linear algebra. Chapter 3 develops the two- and three-variable linear regression model, while most of the econometric material appears in the last chapter on problems of specification, estimation, and verification. The text is at its best in emphasizing these interrelated aspects of econometric work; topics in identification, errors of observation, heteroskedasticity, autocorrelation, multicollinearity and simultaneous equation bias are discussed in this vein. Unfortunately, the book's own structure fails to illustrate the principle; more than two of the middle chapters are devoted to input-output, difference equation and computer simulation models, yet the statistical implications of estimating and testing such specifications go unexplored.

The novice reader will experience difficulties with some of the single equation sections of the book because the estimation problem is only incompletely

presented. A thorough discussion of the properties of least squares is missing (the Gauss-Markov theorem is not mentioned); maximum likelihood methods are set out with little justification for their use. Too often the author fails to distinguish carefully the population parameters from their sample estimates when discussing disturbances and variances of estimated coefficients. While interval estimates for regression coefficients and forecasts are developed, it is remarkable that tests of hypothesis for individual coefficients, structural shifts, etc., are not mentioned.

The weakest material is found in discussions of simultaneous equations. A numerical example to illustrate the need for correct specification is underidentified. Further on the author advises adding different variables to other equations to satisfy the order condition for identification (the rank condition is not mentioned)! In a numerical example of the classic supply-demand model, the text correctly states that the demand equation is not identified but goes on to estimate "demand" functions (and by least squares).

A clear picture of the simultaneous equation estimators and their comparative merits is difficult to obtain, for there is no real discussion of asymptotic distribution theory or its limitations when dealing with small samples. The related problems of prediction and inference about parameters are not mentioned.

Chu's very brief presentation of many of the topics occasions some erroneous implications as byproducts. One numerical example suggests that two-stage-least-squares and instrumental variables using the same predetermined variables yield different estimates, while the discussion of heteroskedasticity implies that ordinary least squares estimates can sometimes have smaller variances than generalized least squares.

In this reviewer's opinion, a short text will better serve the beginning student by a thorough, accurate development and exploration of a smaller number of fundamental econometric topics.

BRIDGER M. MITCHELL

*Stanford University*

*Fundamental Methods of Mathematical Economics.* By ALPHA C. CHIANG.  
New York: McGraw-Hill. Pp. xiv, 690. \$11.95.

This textbook has two purposes: to teach basic mathematical methods and to relate these methods to the various types of economic analysis. It covers the standard topics in elementary mathematics: numbers, sets, functions; matrices and determinants; differentiation and integration; difference and differential equations. There is also a long section on linear programming and games. In addition, a considerable amount of economic analysis is covered: static equilibrium theory, comparative static analysis, consumer and producer optimization, dynamic models of growth and stability. In contrast to most of its competitors, this book is organized along economic lines. Each new mathematical topic is introduced only after it has been motivated by an economic problem. Much effort has been expended to make the technical mathematical detail subordinate to the general line of economic reasoning. This feature is very attractive, even though it often breaks down. (It is hard to believe that a

student can be motivated to read 50 pages on matrix algebra because a supply-demand model has two linear equations in two unknowns!)

Now that mathematics is being used freely in most graduate programs, it has become a serious problem to find efficient methods of teaching elementary mathematics to students of economics. Professor Chiang, like many other textbook writers, has chosen to present basic mathematics and its economic applications in one book. This has the advantage of motivating mathematics to the economist and teaching him more economics at the same time. Yet there are also disadvantages to this approach. Despite the 700 pages of text, many important mathematical topics have had to be omitted (e.g., characteristic roots of matrices are not even mentioned). Furthermore, it is not clear that the student who must learn what an integer is on page 11 will ever get to Routh's theorem on page 500.

There is much to be said for teaching elementary mathematics separately without economic examples; in a later course the applications to economics can be examined in detail. If Chiang could have assumed that his readers knew the very basic material, he could have written a shorter, yet more comprehensive book on the more advanced material.

In general this is an excellent textbook. Indeed, of the many books which present basic mathematics and its economic application, this one is probably the best to appear in recent years. The mathematics is explained carefully and slowly. There are numerous examples and illustrations. Finally, what is very important in a textbook, the typography and layout are excellent, making the book pleasing to read. Despite its length and price, it should be popular among students.

THOMAS J. ROTHENBERG

*University of California, Berkeley*

### Economic Systems; Planning and Reform; Cooperation

*The Soviet Capital Stock, 1928-1962.* By RICHARD MOORSTEEN AND RAYMOND P. POWELL. A publication of the Economic Growth Center, Yale University. Homewood, Ill.: Richard D. Irwin, Inc., 1966. Pp. xxiii, 671. \$9.75.

This is a tour de force. It offers a happy blend of qualities that do not often go together—high analytical subtlety and a keen sense of relevance, judiciousness and daring in treatment of formidable conceptual and statistical stumbling blocks, immense wealth of factual detail and bold generalization. To do justice to Dr. Moorsteen's and Professor Powell's effort within the limits of a book review is impossible; one can hardly do more than indicate what the book is about, and try to convey the sense of its high distinction.

A brief (and beautifully condensed) introductory chapter presents the conceptual framework of the study. It opens with theorems in index number theory that draw on the earlier work of one of the authors<sup>1</sup> and go beyond the "Gerschenkron hypothesis" about the disparity between Laspeyre and

<sup>1</sup> R. H. Moorsteen, "On Measuring Productive Potential and Relative Efficiency," *Quart. Jour. Econ.*, Aug. 1961.

Paasche quantity indexes in a rapidly changing economy. It is argued that, given a shift in comparative advantages in favor of the faster-growing output component and assuming mild concavity in transformation functions as well as broad correspondence between the relative prices and marginal rates of transformation, the Laspeyre index provides a more adequate measure for the increase in an economy's capacity to produce the output mix of a late year, while the Paasche index is a better gauge for the change in the economy's capacity to produce the output mix of an early year. The same analytical technique is then applied to inputs, with production isoquants replacing transformation functions as a diagrammatical device; it is concluded that similar (although much more complex) relationships obtain also with regard to input mixes and output mixes of various years. This sets the stage for discussion of the methodology of capital estimates which, in the authors' words, "are intended to conform to two basic conceptual principles: (i) that assets are valued in proportion to their substitutabilities in use, i.e., their relative productivities, and (ii) that the substitutabilities in reference are those determined by the technology of the *weight* year—alternatively of 1937, 1928, or 1950, for the estimates in prices of each of those years" (p. 7). The paragraphs that follow elaborate on these propositions.

In Part I the basic capital estimates are presented and extensively commented on, with clear warnings on statistical weaknesses and conceptual pitfalls flashed at every step. The net fixed capital series, broken down by kind of assets and by sectors, is based on Soviet estimates of the fixed capital stock net of depreciation and on the sum total of net investments carried out since that date. (The annual investment estimates underlying this calculation are derived from updated machinery output and material construction series compiled and released by the authors at earlier dates.<sup>2</sup>) The authors work with a series of the net fixed capital stock valued in 1937 prices and computed with straight-line depreciation; yet they supply seven alternative calculations of capital stock computed with other methods of depreciation, and demonstrate that the estimated rate of growth would not be substantially affected. The fixed capital estimates in 1937 prices are then aggregated with those of live-stock and inventories into a series of total net capital stock. Part II puts this series to work by examining various aspects of the capital stock's contribution to the growth of the Soviet economy. (On this occasion, incidentally, the reader is offered quite an extra bonus over and above what is promised by the title of the book—a first independent series of year-by-year estimates of Soviet GNP and NNP since 1928; the valuation procedures follow closely those of Professor Abram Bergson whose influence is clearly visible and warmly acknowledged throughout the whole book.) The survey begins with a discussion

<sup>2</sup> R. P. Powell, *A Materials-Input Index of Soviet Construction 1927/1928 to 1955*, The RAND Corporation, Research Memoranda RM-1872 and RM-1873, February 14, 1957 (two parts).

—, *A Materials-Input Index of Soviet Construction, Revised and Extended*, The RAND Corporation, Research Memorandum RM-2454, September 28, 1959.

R. H. Moorsteen, *Prices and Production of Machinery in The Soviet Union, 1928-1958*, Cambridge 1962.



of the behavior of Soviet investment. Next come estimates of Soviet factor productivity, partial as well as aggregate. The latter are computed by a familiar method of using shares of major input groups in national product as weights for their aggregation. With regard to procedures used in this computation, it may be worth noting that (1) the interest charges and rents are, for obvious reasons, imputed rather than actual; (2) the capital inputs are represented not by net capital stock but by a derived series of the annual capital services computed as the sum of depreciation and imputed interest; and (3) labor, capital, and land are summed logarithmically rather than arithmetically in order to allow for imperfect substitutability. The textual presentation is impressively buttressed by a 68-page tabular section and 17 appendixes.

The major findings can be stated as follows:

1. The net capital stock in 1937 prices increased, on the average, by 6.3 per cent per annum from 1928 to 1962. (This period brackets, it should be recalled, four years of war for which the series registers a 25 per cent decline.) The change of estimating procedures (varying methods of depreciation, upward or downward adjustment in estimates of initial fixed capital stock and of livestock) is shown to have no appreciable effect on the annual growth rate: the greatest deviations are of the order of 0.5 percentage points downward or 0.6 percentage points upward. The closely related capital service series increases somewhat more rapidly—at 6.9 or 6.6 per cent per annum depending on whether the imputed rate of interest is taken to be 8 per cent or 20 per cent. However, a change of price weights from the postindustrialization year 1937 to the preindustrialization year 1928 as base, predictably does make a very big difference: it lets the capital stock increase almost twice as fast and capital services slightly more than twice as fast over the whole period. Just as predictably, the difference in the rates of growth between capital series measured in 1937 and 1950 prices is negligible.

2. The Soviet GNP, in 1937 prices, rose at an annual rate of 5.2 per cent from 1928 to 1961. No estimates in 1928 price weights for the comparable period of time are available; but for the 1928-1937 period, for which such estimates do exist, the annual growth rate computed by Bergson in terms of 1928 prices is almost double the growth rate computed by Moorsteen and Powell in terms of 1937 prices. The authors, in keeping with their basic methodology, feel that 1928 price weights are better suited to measuring the growth in the Soviet economy's ability to produce the output in 1937 proportions than 1937 price weights, even though such procedure somewhat overstates this growth. Hence they are opting for a 1928-price-based index for the 1928-37 period which would, in conjunction with the 1937-price-based index for 1937-61, raise the average rate of growth for the whole period to 7.2 per cent per annum. Once again, the difference between the series based on 1937 and 1950 prices is very minor.

3. The share of investment in national product was rapidly increasing over the whole period under consideration. Measured in 1937 prices, gross investment rose from 8.4 per cent of GNP in 1928 to 30.6 per cent in 1961; the increase in the share of net investment in NNP was somewhat larger. Here, too, the difference between estimates in 1937 and in 1928 prices whenever

both are available is truly staggering: the gross investment, measured in 1928 prices, stood at 20.3 per cent of Soviet GNP in 1928 and at 40.5 per cent of it in 1937. Not surprisingly also the comparison of investment volumes measured in prices of these two years shows a substantial disparity, with annual investment increasing less than 20 times between 1928 and 1961 when measured in 1937 prices, and more than 29 times when measured in 1928 prices.

4. The productivity of the aggregate inputs, with both inputs and outputs valued in 1937 prices, and with the imputed rate of interest in that year being 8 per cent or 20 per cent, increased at 1.0-1.8 per cent per annum from 1928 to 1961. An alternative calculation, preferred by the authors, links the output series for the 1928-37 subperiod, computed in 1928 prices, to the output series for 1937-61, computed in 1937 prices, and performs the same operation with regard to the inputs, which are likewise valued in 1927 or 1937 prices for the respective subperiods. The result is a growth range of 1.5 to 3.2 per cent per annum. The authors are undoubtedly right when they conclude that "for any broad appraisal of the Soviet experience, the high growth rate of inputs relative to outputs is the most important finding to come out of this study" (p. 292).

5. The unevenness of the Soviet growth comes through in all these series much more strikingly than in earlier Western estimates that focused on selected benchmark years. The data on the crucial first Five Year Plan period (1928-32) are particularly revealing: the Soviet net capital stock increased by no more than 3.6 per cent per annum between 1928 and 1933; the increase in the GNP over the same period was even more modest. (In both instances, agriculture was very obviously the major culprit, with the livestock component of the net capital stock cut by half and agricultural output reduced by nearly a third under the impact of forced collectivization.) The behavior of the rate of investment was erratic all the way through the mid-thirties, even if its overall trend pointed steadily upward, with fluctuations in inventories and livestock components being particularly severe. But also in later and less turbulent years rapid upward thrusts alternated with periods of retardation. The productivity series faithfully reflected these ups and downs.

The concluding chapter provides a concise and balanced summary. The authors have another look at some of the major methodological problems, restate their findings, sketch out the overall growth pattern that emerges and comment on it. They recognize that "viewed broadly, the rapid-growth path has an evident rationality. Industrialization and increased investment, and also improved education, full employment, the importation of advanced techniques, are all elements of a reasonable program for economic growth" (p. 302). They note "the obvious congruency between these measures and the institutional framework within which they operated: the collective farm permitted a large marketed share of agricultural output; authoritarian government made possible a rapid rate of investment" (p. 302); and they point out that the First Five Year Plan period can be viewed, in an important sense, as reshuffling the proportions so as to set the stage for rapid growth, very much in the spirit of the "turnpike theorem." Yet they are also explicit about massive inefficiencies of overcentralized planning, inadequate adaptation between the form of inputs

and the mix of products, and overcompression of consumption with its negative long-run effects on labor supply. "The consequences of inefficiency," they conclude, "have been some combination of growth at a lower absolute level, at a slower rate, and with greater sacrifice by the population than was necessary" (p. 295).

This reviewer finds little to disagree with here. The differences, whenever they exist, are largely matters of emphasis. I fully endorse the qualifications attached to the use of 1928 prices as appropriate weights for the measurement of the 1937 output mix during the 1928-37 subperiod. But I would have stressed more strongly that while the actual 1937 output mix was definitely more in line with the preferences of Soviet leaders than the pre-industrialization output mix of 1928 or, for that matter, than the wildly imbalanced output mix which emerged at the end of the First Five Year Plan, it was nevertheless more heavily tilted toward "machinery" and against "food" (and, no less importantly, weaker on some of the basic industrial materials) than had been considered safe and desirable from the viewpoint of efficient long-range growth as late as 1934. (It is true, of course, that the unexpectedly strong shift toward armaments contributed to this deflection.) And here we come to a substantive point. I would lend much more emphasis to the phenomenon of incongruity between the nature of the input and the nature of the output targets. To be sure, a certain amount of such tension must by definition be present in every economy that is attempting to restructure its output composition and its technology. But the remarkable thing about Stalinist growth patterns consisted in saddling the economy with targets which were so enormous as to be simply not feasible, short of a miraculous explosion of a resource-saving technological progress, and in refusing to take "no" for an answer with regard to some of the most ambitious and difficult new projects. As Joan Robinson put it in connection with the Czechoslovak economic troubles of the last years, "to carry out investment further than the digestive system of the economy can absorb is a vain sacrifice." And vice versa: the stresses and strains inflicted on the economy by an oversized investment program cut into the effectiveness of the newly introduced advanced techniques and slowed its spread as old and decrepit equipment, manned by unskilled labor force, had to be thrown into the breach. (This reluctance to scrap the obsolescent plant, incidentally, would go a considerable way toward explaining the seemingly paradoxical phenomenon noted by the authors—a rather slow decline in the average age of equipment in spite of a high and growing rate of investment.) True enough, this strategy was carried to the furthest extremes during the First Five Year Plan (which would make it, to stick to the metaphor, an attempt to get to the turnpike by a bumpy short cut and to tear along the main highway with excessive speed, risking flat tires or worse) and was never re-enacted in such a drastic form. But the penchant for "taut planning" remains a built-in feature of Soviet economic policy, to this very day. More particularly, Khrushchev's attempt to abruptly shift the priorities from steel to chemicals during the Seven Year Plan (1959-1965) was another exercise in trying to restructure too much and too soon, with bottlenecks, lengthening of the average gestation period and steep increase in the average capital-output ratio as a

corollary. Lastly, while the Moorsteen-Powell data provide a telling picture of the dramatic decline in output and in *total* capital stock of agriculture during the initial years of collectivization, they also illustrate very graphically the pronounced increase in the *fixed* capital stock of agriculture during the same period—a development which, to a very large extent, reflected the necessity to make up for the livestock disaster but which unquestionably diverted from the capital-goods sector some of the resources which had been earmarked for its self-expansion. This is, by the way, one of the reasons which make this reviewer feel somewhat less certain than he once did (and than the authors apparently still do) that the all-out collectivization was, on purely economic grounds, the most effective way of handling the awesome difficulties created by the Stalinist “oversize push.”

One could extend the list of points about which students of the Soviet economy might take issue with the authors; and those who are, unlike this reviewer, effective producers and not merely users of statistical estimates would surely find many opportunities for lively exchanges on subtler matters of analysis. But it is equally certain that all of them will, after having worked through this book, put it aside with feelings of gratitude and admiration.

ALEXANDER ERLICH

*Columbia University*

*The Socialist Economy—A Study of Organizational Alternatives.* By BENJAMIN N. WARD. New York: Random House, 1967. Pp. ix, 272. \$4.95.

Recent changes in the economic systems of East European countries and the Soviet Union make Professor Ward's study of organizational alternatives under socialism truly topical. The book is distinguished by two features. The first is the high level of abstraction. Though Ward makes frequent references to the Soviet Union, Communist China, and Yugoslavia, his interest lies in contrasting and evaluating alternative abstract models; no empirical support is offered for his contentions concerned with relative production efficiency and viability. Secondly, economic problems are discussed within a broad framework; political, psychological and sociological factors influencing economic behavior are an integral part of Ward's presentation.

The book is divided into three sections. The first part contains a standard outline of the prewar Socialist controversy. The views of Barone, Taylor, Lange, Hayek, Dobb, and Lerner are aptly summarized and criticized. The second part deals with centralized socialism. It opens with the description of three approaches to drafting a central plan: the iterative process leading to inversion of input-output matrix; a scheme by Malinvaud which permits variations in final demand as well as some technological choice; and the Dantzig-Wolfe decomposition principle (perhaps the bloc writers' contributions, such as the Kornai-Liptak scheme, should have been mentioned here). Next, the exposition of the model of soviet type organization is followed by the discussion of two command societies, the U.S. Navy between the Wars and the Jesuit order. These serve as background for the subsequent analysis of command economies. Part three covers decentralized socialism and includes both the recent reforms of the “classical” soviet type model and market syndical-

ism. The latter is an elaboration of the author's paper on the Illyrian economy which was published in this *Review* ten years ago. The extensions cover the problem of decentralized investment activity and its possible weaknesses; the entry and exit of socialist firms; the market imperfections including oligopoly and labor unions; and the role of government in the Illyrian economy as well as some instruments at its disposal. A "control model" of capitalism with three variables (prices, outputs, and employment) and two parameters (money wages and supply of money) is constructed and compared with Illyria. The findings of the book are summarized in a twenty-point concluding chapter.

Parts of the book can be read profitably by any interested layman while others require some knowledge of facts and considerable knowledge of theory. The broad approach chosen by Ward which cuts across well-established disciplines offers a challenge to both the writer and the reader. The latter will find the discussion of the two command societies (U.S. Navy and Jesuit order) independently interesting but will wonder how necessary it is to the understanding of the command economy, or what two command economies are compared in Chapter 6. For this reviewer, the analysis of decentralized market socialism was most interesting. Even with the extensions offered, the model remains very simple and abstract. It is hoped that Ward will find time to elaborate and explain it further, both to satisfy the intellectual curiosity of his Western colleagues and to offer help to bloc reformers who are attempting to create a decentralized socialist market.

GEORGE J. STALLER

*Cornell University*

*Planning and Productivity under Soviet Socialism.* By ABRAM BERGSON. New York: Columbia University Press, distributor for Carnegie-Mellon University, 1968. Pp. 95. \$4.00.

This small but nonetheless very meaty volume by Professor Bergson presents his three 1967 Benjamin F. Fairless Memorial Lectures. Professor Bergson sets himself the very difficult task of evaluating the relative merit of the socialist economic system, as exemplified by the Soviet System. The lectures were presented to an audience composed chiefly of invited business executives. Lest any reader of this *Review* decide that lectures delivered to nonspecialists cannot be of great interest to professional economists, let me assure him that the invited executives must clearly have been a very sophisticated breed. The lectures themselves are pitched at a high level and the notes and appendix on comparative data on productivity are obviously aimed at cognoscenti. As a matter of fact, a few of the passages, presenting some of the most imaginative ideas, require very close reading in order to follow the rather involved arguments.

The volume is an attempt at empirical measurement of the relative economic merit of the Soviet economic system and that of a selected group of advanced Western countries. Bergson argues that economic merit may be gauged by two basic but complementary standards: equity and efficiency (static and dynamic). He decides early in the game to deal solely with

efficiency since he feels that it is decidedly the more novel and interesting standard to apply to the USSR and that it would be difficult to add much to what is generally known on equity in the Soviet Union. While I might be tempted to question his decision to jettison equity on these grounds, and to argue that equity and efficiency alone are not sufficient criteria of economic merit, Bergson has enough to say on static and dynamic efficiency to justify devoting all three lectures solely to the efficiency criterion.

How does the Soviet economic system place in the efficiency sweepstakes officiated over by Bergson? On the basis of comparisons of the productivity of labor, and more important, of labor and reproducible capital inputs, and taking careful account of the divergences between productivity and efficiency (of which more later), Bergson concludes that "Soviet socialism, because of diverse shortcomings, is quite unimpressive in respect of static efficiency. By this standard, it may be comparable to Western capitalism, but only where that system is not functioning very well. In terms of dynamic efficiency, Soviet socialism is more or less a match for Western capitalism generally, but in the West, dynamic efficiency seems very broadly to vary inversely with the level of productivity. It is of interest, therefore, that in terms of dynamic efficiency the USSR seems to be outmatched by a number of Western capitalist countries which are on a par with or surpass it in terms of the level of productivity."

For the static efficiency comparisons, Bergson shows that in 1960 the Soviet real national income per employed worker was 22 or 38 per cent of U.S. levels, depending on the use of Soviet or U.S. price weights, while national income per unit of factor (labor and reproducible capital) inputs was 28 and 45 per cent, owing to the larger supply of capital per worker in the United States. Italy had virtually the same level as the Soviet Union, while France, Germany, and the United Kingdom had much higher levels. For the dynamic efficiency comparisons, Bergson shows that the real national income per employed worker grew at the average annual rate of 4.7 per cent from 1950 to 1962 in the USSR, 2.4 per cent in the United States, 1.9 per cent in the United Kingdom, 4.8 per cent in France, 5.3 per cent in Italy, and 5.6 per cent in Germany. The real national income per unit of factor input shows the Soviet productivity growth in somewhat less favorable terms, due to the very high rates of Soviet investment, with Soviet productivity growing at 2.8 per cent, United States at 2.0 per cent, United Kingdom at 1.4 per cent, France at 4.1 per cent, Italy at 4.7 per cent, and Germany at 4.6 per cent.

Bergson's data show that for the 1950-62 period there is an inverse relationship between a country's level of productivity and the rate of growth of productivity. Taking this into account, the USSR with a very low relative level of productivity has a rather poor record of growth in productivity as compared to Italy, the only country with a comparable level of productivity.

To this reviewer the most valuable aspects of this study were: (1) the extension of Edward F. Denison's work in *Why Growth Rates Differ* to a comparison of the efficiency of the Soviet system with Western systems and (2) the careful evaluation of the various factors (labor quality, unemployment levels, mineral and land supplies, market size) which distinguish efficiency—

the criterion of merit employed by Bergson—from productivity—the initial measure obtained from the empirical evidence. For example, Bergson adapts Denison's method of correcting for differentials in the quality of labor between countries, and shows that the correction for differential education levels and sex composition of the labor force, makes Soviet productivity performance appear somewhat better. He also deals effectively with the questions of differing levels of employment, different availabilities of natural resources, and differing market sizes resulting in different capabilities to benefit from economies of scale.

Bergson also includes a discussion of the very interesting, and usually neglected, question of how worker attitudes toward labor affect the efficiency of an economic system. His general point is that any economic system which can imbue the worker with an attitude favorable to effort, productivity and innovation, is likely to gain significantly in the efficiency sweepstakes. Dealing specifically with the Soviet system, however, he concludes that there is little evidence to support the view that there has been a deep transformation in the worker's attitude toward labor. The greater prevalence of piece work in the Soviet system and the differentiation of money wages are both evidence against the claim that social ownership of the means of production will imbue the worker with a selfless dedication to labor.

Bergson presents a very useful summary of qualitative evaluations of various factors which influence static and dynamic efficiency, e.g., the incentive system and its effect on output mix, on quality, and on the desire to adopt innovations, the objective difficulties faced by the planners in a complex economy, as well as their disdain for, if not hostility toward, economic principles.

He also discusses briefly the factors likely to lead to changes in the efficiency of the Soviet economic system, including a well-balanced discussion of the recent economic reforms. Rather than enlarging this review further, let me suggest to the reader that he consult this excellent brief treatment. He will discover what can and what cannot be done when one of the most sophisticated, knowledgeable, and judicious of Western analysts of the Soviet system attempts to measure and explain efficiency differences between the Soviet and Western economic systems.

EGON NEUBERGER

*State University of New York at Stony Brook*

*Aspects of Planometrics.* By ALFRED ZAUBERMAN, WITH A. BERGSTROM, T. KRONSJÖ, AND E. J. MISHAN. New Haven: Yale University Press, 1967. Pp. xiii, 318. \$9.50.

There are three eras in the history of Soviet economic thought. First came the twenties, a period of great originality in the characterization of economic problems (the chessboard or input-output table), the analysis of growth (Feldman's model), and in applied work (control figures, material balances). Perhaps most original of all was the development of a body of economics which treated economic modernization, the revolutionary transformation of an entire society, as a public policy issue. In the second period, Stalinism, economics became ideology, a handmaiden of the state. Even then, however,

other ways of looking at the economy persisted (Novožilov, Kantorovič), and the ideological system of economics was several times threatened by seeds of destruction sown, one way or another, in the minds of engineers, mathematicians and others. The third period can perhaps be dated as beginning in 1959, thereby marking with Kantorovič's famous book the era of Soviet re-entry into the mainstream of economics. If Western study of the first period is now associated especially with the names of Erlich and Spulber, and of the second with Grossman, the third may now come to be associated with the name of Alfred Zauberman.

Zauberman's book offers brief descriptions and analyses of a broad range of studies in mathematical economics published during the early and mid-sixties. Most of the work was published in the Soviet Union, though other East European countries, and especially Poland, are frequently represented. There are some references to earlier work, most interestingly to that of V. K. Dmitriev, who early in this century formulated mathematically a theory of value which has been mentioned prominently in recent Soviet discussions. Zauberman's theme is the merging of Soviet mathematical economics into the mainstream of Western work. The subject is often given a different name there—planometrics being one of them—and substantive differences can be found, but the strong tendency toward convergence of model structures is plainly apparent. Typically the differences stem from specific institutional features of the Soviet system, such as the need to evaluate foreign trade alternatives on the basis of a national social criterion.

The main topics discussed are the analysis of dynamic equilibrium by von Neumann, input-output, consumer choice theory, the relation of efficiency prices to labor value prices in a theory of production, national economic planning models such as those using the decomposition principle, profit guidance in a centrally planned economy, criteria of investment choice, dynamic programming and capital accumulation, and the planning of foreign trade. References to the Western literature tend to be rather more cryptic than those in the Soviet literature and it is often true that a reader who is unfamiliar with the former will not understand clearly what is being said about the latter. However, with respect to the very limited range of topics in which this reader had some familiarity with both Soviet and Western studies, he found Zauberman's discussion accurate. A final section compares the techniques used by French and Soviet plan makers and finds the similarities more striking than the differences.

Zauberman's case for analytic convergence is established beyond reasonable question, at least for the period of major emphasis. One cannot help wondering, however, whether Soviet writers are not "copping out," on the big issue of the kind of analysis appropriate for problem solving in contemporary society, by accepting essentially bourgeois criteria of problem definition and concept formation. Perhaps there is too much orthodoxy in economics, in particular too much concern with the design of institutions which serve either an egocentric or mechanistic conception of human nature, in which decision makers are always either self-serving individuals or teams applying an assigned criterion. Why are the Soviets not grappling, however crudely, with problems as exciting



as those that occupied them in the 'twenties, or is this to be the specialized concern of Chinese and Cubans in the grand Marxist scheme of things? It is depressing to see the brilliance available for economic investigation in the Soviet Union turned to the minor elaboration of such topics as infinite utility streams, stochastic games, and the like, when virtually no authors are exploring systemically alternative designs for a humane social framework within which to apply the results. Perhaps it is a passing phase, associated with remaining ideological constraints plus constraints imposed by the logic of intellectual catching up. At any rate, it will be quite disappointing if it turns out that these *are* the interesting problems in Soviet economics.

Zauberman has attempted to provide neither a history of Soviet mathematical economics nor an analysis of the relation between theorizing and practice, though there are occasional comments on the latter topic. He has provided a clear picture of the state of the Soviet art of economic model building over a period of extremely rapid growth, and a description of individual studies in sufficient detail that, in general, the reader may fairly judge whether the original study is itself worth reading. The material is helpfully organized and supplemented on occasion with penetrating analyses by the author. It is a very useful book.

BENJAMIN WARD

*University of California, Berkeley*

*The Visible Hand: The Fundamentals of Economic Planning.* By GERALD SIRKIN. New York: McGraw-Hill Book Co., 1968. Pp. 191. \$5.95.

There are a variety of reasons for which a book covering the fundamentals of economic planning may be written. Among these, the more notable ones might be: (1) no such book exists on the market; (2) there are several books on the market, but none explains the fundamentals in a comprehensive manner; and (3) economic planning has never been discussed within the framework of development planning. None of these reasons is pertinent to the aim of the book under review, for to dispel the confusion and myths which surround economic planning is one of the prime objectives of this book. I find this to be a negative and distressing approach to the subject. As a matter of fact, the first chapter, which is entirely devoted to a discussion of the confusions and illusions of planning, appears largely irrelevant.

A second major deficiency of the book is a very sketchy and incomplete discussion of the processes of economic planning in developed countries and in India. For instance, in 37 short pages (Ch. 5), the author completes his discussion of the basic approaches to economic planning in five countries (France, U.S.S.R., Yugoslavia, the Netherlands, and others); in sharp contrast, in *Planning and Economic Development*, edited by Everett Hagen, over 350 pages are devoted to examining planning processes in nine countries. Perhaps the author's objective is to highlight only the differences in planning processes. Sirkin does succeed in meeting that objective.

I would now like to take issue with Sirkin regarding his definition of planning. According to him, "Planning is the attempt, by centralizing the management of the allocation of resources sufficiently, to take into account social costs and social benefits which would be irrelevant to the calculations of the

decentralized decision maker" (p. 45). This definition puts too much emphasis on centralization of management, and consequently excludes all the planning done at the private-sector level. Consistent with his definition of planning, Sirkin's discussion is geared primarily to an examination of the role of government in economic planning. I consider this to be a drawback, since in many countries the contribution of private enterprise to economic planning is of vital importance.

The fourth drawback of the book is its partial failure to fulfill the promise conveyed by the title, "Fundamentals of Economic Planning." This title suggests that the author intends to lay down *all* the fundamentals of what planning is and how economic plans are implemented. Sirkin discusses only *some* of the fundamentals of planning, and ignores almost completely the problems of the execution of development plans.

Having noted some of the book's chief drawbacks, I now turn to its strong points. It certainly is well written. The author's style is lucid, and, although he does not say so, he has written the book for the interested layman who has had the equivalent of at least a year's basic training in economics.

The second good feature of the book is the concluding chapter. Here the author integrates the results of his inquiry into the principles and practices of planning, summarizes the conclusions he has reached, and prescribes his own formula of what the role of government in economic planning should be.

Sirkin must also be commended for his thorough analysis of the functioning of a market system, the means for improving the functioning of markets, and the ways in which the inherent defects in the market mechanism could be removed.

I find Chapter 3, "Planning—A Word in Search of a Meaning," and Chapter 4, "Government in the Economy: Portrait with Warts," especially delightful. In the former chapter, Sirkin states categorically: "Planning is not tied to any specific form of economic organization. It may be applied with or without the price mechanism, in a system of either private or public ownership of productive property; it may be centralized or decentralized; it may be partial or total" (p. 54).

In Chapter 4, Sirkin attacks centralized planning. He writes: "The problem of decision making under uncertainty cannot be met by seeking certainty or by pretending to have found it. The methods of dealing with uncertainty are varied, but chief among them are techniques for maintaining flexibility and adjustability of decisions as circumstances unfold. In this respect central planning, with its rigid schedules and overburdened administrative apparatus, is at a distinct disadvantage compared with the market system" (pp. 76-77). Such statements are to be found throughout the book.

In my judgment, *The Visible Hand* could not be used as a textbook because it does not deal effectively with *all* the basic fundamentals of economic planning. Neither does the author apply planning theories to planning practices. But it is a delightfully written book which could be used as a supplement to a solid textbook on planning at the undergraduate level.

SID MITTRA

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### Business Fluctuations

*Cyclical Fluctuations in the Exports of the United States Since 1879.* By ILSE MINTZ. NBER Studies in Business Cycles, No. 15. New York: Columbia University Press, 1967. Pp. xx, 332. \$10.00.

With this volume the National Bureau of Economic Research not only fills a gap in our knowledge of the cyclical behavior of GNP components but also provides a factual answer to an important question that has been discussed for some time by theorists and policy makers as well as in the press, namely, whether a country's exports are stimulated by recession or by prosperity in the domestic economy. Indeed, before the question of the influence of domestic business conditions on exports had been raised it might not have appeared promising to analyze exports by the NBER method, under which cyclical phases, amplitudes, and turning points of the time series to be analyzed are compared with the corresponding characteristics of cycles in domestic economic activity in general (reference cycles). It might have been supposed that exports are chiefly affected by business conditions abroad, that—in the United States—their influence on general economic activity is small, and that a statistical juxtaposition of export fluctuations and reference cycle movements is for these reasons unrewarding. The attempt to test the rival hypotheses, the traditional view that exports move inversely to the domestic cycle or the expansionist notion that they move in the same direction as domestic activity, provides thus at the same time the justification for undertaking this study and its focal point.

After a discussion of the two hypotheses and of the data and methods, Dr. Mintz analyzes the degree of instability of values, volumes, and prices of total U.S. exports and four components: finished manufactures, semi-manufactures, crude materials, and foods. World War I divides the period into two subperiods, from the second of which not only war years but also the depression of the 'thirties was omitted for most analytical purposes of the study. An interesting finding of this section is that, contrary to traditional views, fluctuations in the quantity of nonmanufactured exports, just as those of manufactures, by far exceeded the corresponding price fluctuations, and that quantities and values of nonmanufactures were much less stable than those of manufactures.

In the main part of the study, movements in U.S. exports and their components are compared with changes in world imports (excluding U.S. imports), as representing external demand, and with changes in domestic economic activity. As expected, a large part of the variation in U.S. exports is explained by the world import cycle, though there are interesting differences in the apparent dependence of quantities and prices of various commodity classes on world demand. The assessment of the separate effect, after allowance for the influence of world demand, of variations in domestic activity on U.S. exports is made difficult by the fact that world imports are to some extent correlated with the U.S. business situation. Pursuing this question with the painstaking care which we have come to expect from studies issued by the NBER, the author comes to the rather firmly expressed conclusion that, given the level of world demand, domestic prosperity has not, in any pronounced way, either in-

creased or reduced total export quantities or values, nor has domestic recession either retarded or advanced the growth of exports. Manufactured exports clearly moved with, rather than against, the U.S. cycle and, although export quantities of other commodity classes varied inversely to the domestic cycle, the effect of this on export values was to some extent offset by price movements which were in sympathy with the domestic business situation. The policy conclusion from these findings is that "repression of home demand thus would not, on the basis of historical experience, appear to be a promising route for achieving a rise in the total value of U.S. exports" (p. 279).

This is, of course, a rather important conclusion, even if it were to apply only to the United States where domestic business activity has a more pronounced effect on world demand than is the case for any other country. Because of its importance, one would like to see this result checked by more conventional econometric techniques which would furnish us with the appropriate measures of reliability and point to problem areas such as the degree of multicollinearity between indicators of domestic business activity and world demand. The NBER method is not well suited to the kind of multivariate analysis required in this case and, although it has been carried as far as it will go, it leaves important aspects of the problem to further research. There can be no doubt, however, that Dr. Mintz has made an impressive pioneering contribution toward the solution of an important practical question.

RUDOLF R. RHOMBERG

*International Monetary Fund*

**Money, Credit, and Banking; Monetary Policy;  
Consumer Finance; Mortgage Credit**

*Critical Essays in Monetary Theory.* By J. R. HICKS. Oxford: Oxford University Press, 1967. Pp. xi, 219. \$6.00.

The essays which Professor Hicks presents in this book fall into three major categories: (1) the two reprinted—and by now classical—papers of the 1930s on "A Suggestion for Simplifying the Theory of Money" and "Mr. Keynes and the 'Classics'"; (2) new or partly revised essays of the last ten years dealing with the same problems as these two papers; and (3) three new essays in the realm of the history of monetary doctrine, dealing respectively with Thornton's *Paper Credit*, Keynes's *Treatise*, and Hayek's *Prices and Production*. It is only with the essays in the first two categories that this review will be concerned.

"Mr. Keynes and the 'Classics'" most justifiably continues to be required reading for all economic students. Its basic message—which it shares with the interpretative essays of Lange and Reddaway, published about the same time—is that the Keynesian system should be viewed as a specific instance of a general-equilibrium model. The influence and fruitfulness of this approach is adequately attested by the whole development of Keynesian models in the years after the *General Theory*. A second aspect of this essay, however, seems to me less justified; namely, its emphasis on the "liquidity trap" as the distinguishing feature of Keynes's theory of unemployment.

The nature of Keynesian economics is also the subject of a 1957 paper, here reprinted (with some changes) as "The 'Classics' Again." In this paper Hicks deals instructively with the different assumptions about price flexibility made by Keynes and the classics. He recognizes that unemployment can exist not only because of the liquidity trap, but because "saving and investment may themselves be insensitive to changes in the interest rate" (p. 154). But he fails to take the further step of explicitly interpreting this unemployment in terms of a *disequilibrium* system.

I would also take exception to some of Hicks's *obiter dicta* on doctrinal questions. Thus I cannot find support in the literature for his contention that classical economists "disliked" recognizing even the temporary effect of a monetary expansion on the rate of interest, and that the recognition of this effect declined after 1850 (p. 150). Similarly, it is not correct to identify the classical and neoclassical discussion of this temporary effect with their discussions of the permanent effect on the interest rate of "forced savings."

Hicks's "Suggestion for Simplifying the Theory of Money" (1935) has worn even better with time. Though explicitly drawing on Lavington and Keynes of the *Treatise*, it still stands as one of the earliest systematic presentations of the modern portfolio approach to the theory of money—a presentation which can continue to be read with profit by every student of monetary theory. The influence on the demand for money of yields of alternative assets, costs of making an investment, uncertainty of yields—as well as an embryonic discussion of "increased dispersion [as a measure of] uncertainty" (p. 69)—are all there.

A far more formal and systematic analysis of the problem of choice under uncertainty is presented in the essay on "The Pure Theory of Portfolio Selection," which is a revision of the 1962 *Economic Journal* paper on "Liquidity." One feature which continues to mar this paper even in its revised form (though much less so the leading essay of the book; see p. 19, footnote 1) are the inadequate references to the work of Markowitz and Tobin. Hicks implicitly criticizes the work of these two writers on the valid grounds that the rationalization of the mean-variance criterion on the basis of maximizing expected utility with a quadratic function leads to "a very special kind of indifference map" (p. 115). But surely the way out of this difficulty is not to arbitrarily posit a mean-variance criterion (or even a mean-variance-skewness criterion) without any theoretical underpinning whatsoever.<sup>1</sup>

Hicks's analysis of portfolio selection provides part of the background of the leading essay on "The Two Triads," which comprises more than a fourth of the book. This essay represents a revision and extension of a series of lectures presented at the London School of Economics in 1966, and is here published for the first time. Its main concern is the relationship between the traditional classificatory "triad" of money as a unit of account, medium of exchange, and store of value, on the one hand, and the Keynesian "triad" of transactions, precautionary, and speculative balances, on the other. There are

<sup>1</sup> For a constructive approach to these as well as other problems, see the forthcoming paper by Giora Hanoch and Chaim Levy on "The Efficiency Analysis of Choices Involving Risk."

several points in this essay at which I find the argument fuzzy (e.g., pp. 8-10). Nor can I agree with Hicks's contention that the "transaction demand" does not represent a "voluntary" demand, but "is the money that is *needed* to circulate a certain volume of goods, at a particular level of prices" (pp. 15 and 16, italics added). Surely history has shown that, for example, the amount so "needed" (in real terms) in hyperinflation is much smaller than in periods of stable prices; and Cagan has shown us that this difference can in many cases be explained in terms of a voluntary decision based on the cost of holding money balances as measured by the rate of increase of the price level. And surely the money substitutes which Hicks himself describes will also influence the amount of money held for transactions balances.

Furthermore, even if utility theory is not appropriate for analyzing the transaction demand for money, this does not mean that the concept of "voluntaries" is inappropriate. For we should then develop a production-theory (e.g., an inventory-theory) approach to the transactions demand, which would also imply that the individual is making decisions based on comparisons at the margin with the rate of interest and other economic variables.

Hicks also discusses the real-balance effect, which he identifies with his "liquidity pressure" effect (pp. 51-52). He claims that this effect can operate to restrict current demand for goods and services, but not to stimulate it. Though there are good reasons to doubt the efficacy of the real-balance as an anti-deflationary device (the weakness of the effect, the adverse expectations it generates, and the like), I do not think we advance our understanding of the relevant issues by arbitrarily assuming that individuals have a "kink" in their behavior curves which makes them react actively to decreases in their real cash balances, and passively to increases.

Hicks identifies Keynes's speculative demand for money with the Markowitz-Tobin risk-aversion demand, and provides an instructive graphical analysis of this demand (pp. 19-28). The precautionary demand he identifies with that generated by the uncertainty of the timing of payments and receipts (p. 34). Tobin himself, however, identified Keynes's speculative demand with "bearishness" about future bond prices<sup>2</sup> (as Hicks himself does at other points—e.g., pp. 44-45); the risk-aversion demand, as Johnson has emphasized,<sup>3</sup> is more properly identified with the precautionary demand.

In any event, Hicks's conclusion on the "Two Triads" is the not surprising one that the speculative and precautionary motives are associated with money as a store of value, whereas "the transactions requirement . . . arises out of the functions of means of payment and measure of value" (p. 37). Hicks also connects his speculative demand with money as a "measure of value"—by which he means that there is certainty about its value: that is, "some confidence (some minimal confidence) in price stability" (p. 28). But this is surely not a necessary condition. For as Hicks himself recognizes (*ibid.*), money could be held as a component of an optimally composed portfolio even if its future value (in terms of purchasing power) is uncertain.

<sup>2</sup> "Liquidity Preference as Behavior Towards Risk," *Rev. Econ. Stud.*, Feb. 1958, 25, 70, 85.

<sup>3</sup> "The General Theory After Twenty-Five Years," *Am. Econ. Rev., Proc.*, May 1961, 51, 8.

For these and other reasons, I feel that Hicks would have done better to present his interesting discussion of the demand for money without straining to place it within a framework of relationships between "Two Triads." I also feel (though this is quite a different, and obvious, point) that in view of the attention which Hicks devotes to classificatory systems, he might well have emphasized that no matter what the system, it is impossible to separate total money holdings into physically distinct component parts—and that at the margin each unit of money is held for all the reasons simultaneously that one holds money balances.

DON PATINKIN

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*Money, Wealth, and Economic Theory.* By BORIS P. PESEK AND THOMAS R. SAVING. New York: MacMillan; London: Collier-MacMillan, 1967. Pp. xv, 448. \$9.95.

This book is about "Wealth" and all the wondrous things one can do with it once its theoretical significance is fully appreciated. I submit that a better title for Messrs. Pesek's and Saving's (hereinafter referred to as P&S) book would have been *The Apotheosis of Wealth*. For example, Part I, consisting of two chapters, is titled "The Origins of the Wealth Effect." Part II, "Money and Wealth," has seven chapters and together with Part I makes up roughly two-thirds of the entire book. This review will concentrate on this major part of the book for the additional reason that it also forms the theoretical basis for their more recent money textbook *The Foundations of Money and Banking* (New York, 1968). The remaining third of the book covers such topics as nonmonetary wealth, wealth and consumer behavior, and wealth in macroeconomic analysis. These are simply the logical extension of the arguments developed in Part II.

In Keynesian theory, as we all know, money affects income *indirectly* through the rate of interest, whereas in Friedmanian theory money has a *direct* impact through the wealth effect. The issue at stake, which P&S must resolve, is whether a change in the money supply leads to a change in net wealth, i.e., whether money supply changes have a wealth effect at all. It is, of course, important that this be answered in the affirmative since, if not, there would be no point in continuing the book. It must be stressed, however, that the wealth effect in P&S is not a matter of empirical existence. To put matters bluntly, what P&S are about is a theoretical structure in which the wealth effect is crucial. In short, what we have is a wealth model whose empirical usefulness or applicability is largely beside the point. Simply put, the problem is that money has long been regarded as an asset for holders and a debt for issuers, and clearly the two must balance each other out in the aggregate. If this is so, then a money supply change would leave net wealth unchanged. P&S are very explicit on this matter (p. 42):

We think that the view that money is an asset that is offset by a debt of the same magnitude has been accepted too readily. We intend to show that money is a part of net wealth and that the current view of money as an

asset of the owner that is offset by a debt, of equal magnitude, of the issuer is erroneous.

Then for 200 pages we are treated to a turgid one step at a time analysis of a model which proves what it initially set out to prove. But this is not a difficult thing to do in pure theory provided that one makes all the necessary, and hopefully minimum, assumptions. P&S begin by analyzing the case where commodity money is introduced into what had been a purely barter economy. The use of commodity money leads to an increase not only in consumption itself but to leisure as well. If, as P&S expect, part of this increased leisure is used to increase the stock of capital, then clearly the introduction of commodity money has led to an increase in wealth, and insofar as any increase in commodity money saves time in barter transactions, there will be a further addition to net wealth. It is as simple as all that. The value of commodity money itself is a part of the community's wealth "because it yields a positive income stream to the users of it *which is not offset* by a negative income stream to the nonusers" (p. 48, original italics). For this reason, it is not a debt and must be included as part of a society's wealth. Finally, the *producers* of commodity money have no obligation for their end product once it has been sold, i.e., their liability for commodity money is nonexistent. For example, suppose refrigerators (to use their illustration) were the commodity money employed. The services of refrigerator-money are twofold: refrigeration, and time saved in barter transactions. If the producers of refrigerators double their output, then the money supply has also doubled. Yet, since all sales are final, there has been an increase in net wealth with no increase in corresponding debt. Or, to put it in the words of P&S, ". . . since it is a wealth for the owner and it is not a debt of either the producer or society, money must be net wealth."

There would be something innocently disarming about P&S's argument if it weren't so conveniently forced and if it weren't so totally irrelevant to the actual world we live in. But then again, this is only the first step. The argument is next extended to include the case of fiat money. "Net wealth under fiat money increases even more since monopoly production of [fiat] money will utilize fewer resources than would be utilized under competitive conditions, [and] thus the community has more resources available for the production of non-money capital goods . . ." (p. 73). We are told, furthermore, that this is one instance where monopoly is preferable over competition because the monopolistic producer (private or governmental) will be able to choose "a lower value and lower production costs than one produced by a competitive money industry." Ergo, more resources are left over for other uses with the net result that wealth is further increased. And as if this reasoning were not enough, P&S clinch the argument as follows (p. 74):

Suppose that the money commodity has some other use and that someone, again, replaces this commodity with fiat money. As far as the services of money are concerned, the community is getting no less income than before, and it is now able to rechannel the money commodity that has some other use to this use: it must be better off.



I fail to grasp this last point. Suppose the original commodity money were refrigerator-money. Surely, as commodity money, refrigerators continue to provide refrigeration—or are refrigerators as commodity money never plugged in? If, however, the commodity money were tobacco, then, in the exclusive sense of the alternation, it could provide either smoke or serve as a medium of exchange, but never both simultaneously. In this case, unlike the case of refrigerator-money, the switch to fiat money would result in an increase in the wealth of the community. In short, it all depends on the commodity money employed. But this is all very silly and we should get on with the argument.

So far, P&S have made their case for an increase in net wealth in terms of a society which has switched from barter to commodity to fiat money, i.e., primarily in terms of the resources freed and thus applied to the creation of non-monetary (real?) wealth. But what about the case of bank-created money? James Tobin, the oft-quoted *bête noire* of P&S, is once again set up as the straw man of their analysis. Tobin's view is that bankers, unlike governments, "cannot create means of payment to finance their own purchases of goods and services . . . [because] bank-created 'money' is a liability, which must be matched on the other side of the balance sheet." This would seem to be a reasonable position to take, but P&S are intent to show, as they must if their theory is to have any current application, that bank-created money must be counted as part of a society's net wealth. Apparently the argument could be applied, *mutatis mutandis*, to show that bank-created money as a substitute for commodity money would result in an increase in a community's net wealth, as was found to be the case by P&S in the switch from commodity to fiat money. But the switch from fiat money to primarily bank-created money comes up against the old asset-liability problem. Clearly, this distinction must be done away with.

The solution is simple. If one denies that bank-created money is a liability for the issuer, then all one has left is an asset! And *voilà*, one has arrived at one's long-sought destination with dispatch. P&S show a great deal of imagination in attacking Tobin's position. They assume, first, that the only money in circulation is fiat money, which is issued by the government acting as a monopolist. Next, they assume that the government "allows certain firms to enter into the production and sale of a substitute for dominant [fiat] money" under two preordained conditions: (1) that "convertibility into dominant money on the demand of a private money holder is guaranteed at a fixed exchange rate, [e.g.], at a one-to-one rate," and (2) "that private money producers are prohibited by the government from stimulating demand by bribing their customers: they are forbidden to pay interest to the holders of bank money" (p. 80). In addition to this instant repurchase clause and the prohibition of interest rates, P&S look upon banks as firms producing a final product which, once "sold," absolves them of all further responsibility, i.e., "all sales final." Applying the principle of *caveat emptor* to the banking industry is extraordinarily convenient for what P&S want to prove, since if all sales are final "the money sold cannot be a debt of [the banks] and therefore [surprise!] the money must be net wealth," or, more specifically,  $\Delta w = M_P/P$  where  $w$  = wealth,  $M_P$  is the private money produced by banks, and  $P$  is the price level, assuming the resource cost of  $M_P$

is zero. Of course, banks will not proceed, merrily, to produce an unlimited amount of money. There exists some finite output under the assumption that fiat money and bank-created money are not perfect substitutes. Given the instant repurchase clause and the prohibition of interest rates, there exists some proportion of fiat to bank-created money which will make consumers indifferent at the margin—which conveniently places a limit on the amount of private money that can be sold. From here on in, the argument gets more complex as the role of inventories of fiat money and a budgetary constraint are introduced, with the liabilities of nonbank financial intermediaries (including the time deposits of commercial banks) excluded from the definition of money since the asset-liability problem can not be resolved.

There is one remaining matter which must be confronted. If banks "sell" their product on a "sales final" basis, what do the consumers use to "pay" for their demand deposits? The consumers can pay for them in cash (primary deposits), i.e., with fiat money, or they can purchase them on the installment plan, i.e., by pledging and thereby giving the banks a financial asset, namely, some finite claim on the consumer's income stream.

This is all very fanciful and P&S admit that these special contractual arrangements "are not typical in the case of transactions involving nonmonetary wealth," but then they do have the virtue (as far as P&S are concerned) of exploding Tobin's arguments.

I can't help feeling that the gargantuan efforts of P&S represent a high level of analytic ability gone wrong. Their book stands as a monument to the futility of logical systems in vacuo. Most of all, they lack a sense of relevance. They are intent on playing games, i.e., what do we have to assume in order to reach a certain conclusion regardless of whether we do violence to things as they are.

By now, we have reached page 254 of P&S's book. The remaining 156 pages (excluding the summary and conclusion) are extensions of the arguments already reviewed. There is little point in extending this review any further. The reader has had a good taste of the product and he is left to his own defenses and the peculiarities of his utility function.

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*The Theory of Interest.* By FRIEDRICH A. LUTZ. 2nd ed., transl. by C. Wittich. Dordrecht: D. Reidel Pub. Co.; Chicago: Aldine Pub. Co., distrib., 1968. Pp. ix, 336. \$13.75.

This book is primarily a survey of the past development of the theory of interest since the latter part of the nineteenth century and of the present state of the art. The book is divided into five parts. First come critical discussions of the neoclassical theories of interest, with the stationary economy undertaken in the first part, whereas the "progressive economy," that is, the economy with net savings and investment is examined in the second part. The author discusses in these two parts the stationary state theories of Böhm-Bawerk, Wicksell, Akerman, and Hayek and the "progressive state" theories of Walras, Irving Fisher, and Knight.

The third part of the book discusses interest rate theories in which monetary influences are dominant. Here we mainly find the theories of Keynes and his contemporaries and post-Keynesian theories in which liquidity factors participate in interest determination.

The fourth part ends the historical surveys with a discussion of theories of the term structure of interest rates—including, naturally, analysis of the role of expectation and uncertainty.

Finally, the fifth part of the book presents the author's own theory of interest determination. He starts with some partial equilibrium theories incorporating mainly liquidity and monetary factors. He discusses "The Market for Money and Capital: Only One Rate of Interest," and then he extends the theory to "The Market for Money and Capital: Several Interest Rates." The first part includes mainly liquidity and uncertainty considerations while the second part includes discussions of the demand for capital generated or derived through the productivity of capital. The second part also deals with the author's theory of term structure of interest rates. The following discussions introduce the banking system and its impact on long- and short-term interest rates through factors like reserves and bank liquidity. In the last chapter, the author presents a general equilibrium model for interest determination. It is essentially a two-sector model, that is, a consumption and capital good sector each with its own production function, with the monetary side of the economy incorporated into the model. It is an attempt to synthesize the monetary theories on the one hand, with the neoclassical theory on the other hand. The theory is static, dealing with the determination of the interest rate at a point of time.

Both in its discussions of economic doctrines and in its development of new ideas, the book is a very valuable contribution to the existing literature on interest rate theory. Some of the neoclassical theories discussed are not accessible to the English reading audience. Furthermore, an analytical discussion which emphasizes doctrinal developments from one economist to the other, leads to a higher total than the summation of individual parts. Understandably, however, the selection of topics out of a field as wide as the theory of interest, and the weights assigned to various considerations, are to a large degree a matter of taste; and on occasion, I would have preferred some change of emphasis. Thus, the contribution of Lange on the role of the interest rate would, it seems to me, deserve some mention, whereas the discussions of Hayek and Knight might have been shortened. In spite of the heated controversies between the latter in the 1920s and 1930s, and their impact on their contemporaries, I believe that Wicksell and Lange are more significant as stepping stones on the road to our present thinking. It would also seem to me that the book is not entirely well balanced in its discussion of more recent developments and especially neglects the analyses of capital accumulation and growth developed since the late 'fifties, to which the whole subject of interest rates must be intimately connected.

The author's own model contains just one capital good, and as such is open to many of the criticisms the author has raised in his evaluations of Wicksell and others. Thus, either the unrealistic assumption of one capital good is

made or that one thinks in terms of weighted aggregates but then the weights include the interest factor so that cyclical reasoning is involved. The theory, as has been mentioned, is static, and completely ignores the time element and dynamic forces like labor force growth or capital accumulation. The model is in line with the integration of Patinkin, including the real and monetary sectors and the determination of interest by the interactions of the two. The attempt to integrate real and monetary theories is welcome; it would seem to me that the author's model is a good starting point for further investigations aimed at this integration.

In conclusion, this volume fills a gap in the literature of interest rate theories, and should render useful service to students of this field.

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*The Foundations of Money and Banking.* By BORIS P. PESEK AND THOMAS R. SAVING. New York: The MacMillan Co.; London: Collier-MacMillan Ltd., 1968. Pp. xxvii, 525. \$8.95.

Pesek and Savings's (P & S's) money and banking text is unquestionably the best I've ever read. It is not another version of the standard text but a fresh, new approach. The book depends importantly on their recent treatise *Money, Wealth, and Economic Theory* where they applied economic analysis to explain what money is, what it does, how much people want, how much is produced, and what are the resulting consequences for the economy. The text is concise, interesting, and clearly written. It covers not just economic theory but includes a good exposition of American money and banking institutions and a short but adequate history of their development. The gap between monetary economics of the journals and textbooks has been widening ever so much; P & S have narrowed the gap.

The book is arranged into nine parts: (1) Introduction, (2) Trade and Credit: Some Fundamentals, (3) Theory of Money, (4) American Money Industry, (5) The Credit Market, (6) Monetary Theory and Policy, (7) Brief History of Money and Banking in the U.S., (8) International Monetary Relations, and (9) Summary. It includes lists of interesting questions and problems and a selective bibliography at the end of each of the quite short chapters.

Despite these very favorable comments, the text has some serious shortcomings. P & S are wrong with respect to banks being money producing agencies rather than issuers of their own liabilities. They are wrong in interpreting the competitive struggle for savings deposits. They largely ignore the micro-economic analysis of the demand for particular money services and equally the application of that kind of analysis to the supply of money.

The authors argue that deposits are assets to holders but not liabilities to banks. Producing deposits and selling them on credit adds to a bank's earning assets and correspondingly to its net worth, and not to liabilities, according to their argument. Demand deposits allegedly are not liabilities to banks because they don't require interest payments.

The flaw in this argument is that banks, unlike the government, are legally

bound to repay depositors. P & S term this a repurchase clause in a bank's sale of deposits. It requires banks to remain solvent by keeping relatively short-term assets denominated in money and not using the proceeds of sales but only the income. But banks are precisely like other debtors in this respect. They must be prepared to repay under prescribed terms or face the consequences. P & S put it very well themselves:

... The solvency requirement under which commercial banks operate is not an independent restriction, additional to the repurchase clause, but merely one implication of it. Notice that this means, in contrast with other sellers of goods, that the banker must not consume the proceeds realized from his sales of bank money. All he is able to do is to enjoy the income (net of the cost of running a bank) these proceeds yield (p. 73).

Since banks are unlike other sellers of products, it is reasonable to class them as what they are like, namely issuers of liabilities that promise to repay government-issued money.

P & S put great emphasis on the nonliability nature of demand deposits, presumably to make the wealth effect just that much stronger. They are right in arguing that banks provide valuable services. Banks have an associated net worth that is indubitably part of national wealth. But so is everyone's. Of course, money must be kept artificially scarce where costs of producing it are negligible. The constraint of reserve requirements and limited issue of government money (and government debt) does limit deposits but it does not permit banks to pocket monopoly profits. Where large numbers of banks compete individual banks would continue to increase the value of services to consumers (implicit interest) and thereby costs until more than normal profits were eliminated. Banks are no different than other enterprises in this respect. P & S have gone too far by including demand deposits as part of the national wealth simply because banks don't pay interest on demand deposits. One implication of their proposition is that removal of the demand deposits interest ban would reduce national wealth, reduce planned spending and the price level. A counter argument is that permission to pay interest on demand deposits would remove an artificial constraint on banks, increase the value of their services and the community's wealth. Banks could issue additional deposits for a given setting of policy instruments. Both the *increase* in money and in wealth would induce price inflation. According to P & S the prohibition of interest on demand deposits in the 1930s would have increased wealth and had an important inflationary effect. Maybe so, but I doubt it! It does not seem reasonable, particularly in an elementary text, to have placed so much emphasis on such unconventional wisdom.

Two aspects of P & S's discussion of competition for savings are hard to accept. First, P & S initially add the outright amount of required and working reserves to operating costs per period to find the total production cost of deposits. This is a stock-flow error. Subsequently the expression is properly transformed by calculating the present value of operating costs and adding them to the stock of reserves. Why wasn't the cost of reserves expressed as a flow initially or at least indicated as an error? Second, P & S can be chal-

lenged because their argument fails to take account of the setting within which the competition for savings occurs. Wealth holders adjust their portfolios to the available services and prices of assets. A disturbance of that equilibrium by a changed demand for the time deposit obligations of a particular bank would cause repercussions throughout the economy until wealth got redistributed to satisfy the new preferences and expectations. Those institutions that provide services most cheaply would get the business in the long run. Unprofitability of time deposits in the short run has often been argued as in P & S on the assumption that the stock of government issued money is constant. The consequences for the profitability of time deposits in the short run are far different if the Federal Reserve were to supply sufficient reserves to permit banks to support time deposit growth in addition to demand deposits. The Federal Reserve does just this when it holds interest rates at particular target levels in the face of changes in demands for particular financial assets or when it takes account of the implications for aggregate demand of a shift away from money holdings, i.e., when the Federal Reserve changes the reserve base enough to permit the equilibrium wealth distribution to be established without price level adjustments.

Let me conclude on the note that the book is really very good and is well worth serious consideration as a textbook for students who understand some principles of economics. One can quarrel on a substantive basis with some parts of the book, but only because the book has substance.

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*An Introduction to the Theory of Finance.* By BASIL J. MOORE. New York: The Free Press; London: Collier-MacMillan, 1968. Pp. x, 299. \$5.95; paper, \$2.95.

Students who attempt to master recent developments in the theory of finance have to read through a series of original contributions by Metzler, Patinkin, Gurley and Shaw, Markowitz and Tobin *et al.* The complexity and sophistication of the work, however, often require them to rely heavily on skillful exposition by a competent instructor of the original work. In this book, the author skillfully puts together these contributions in a broad context of the theory of financial management, so that students can easily comprehend them. This book, therefore, is well designed as a text for the first-year graduate course or for an advanced undergraduate course in monetary theory or in the theory of business finance.

After a brief sketch of financial thought in Chapter 1, the book presents the theory of asset choice under uncertainty in Chapter 2, including the concepts of "efficient portfolio" opportunity curve and the indifference curve between the expected return and risk. Chapter 3 develops the theory of a consumption function based on the permanent income and the life-cycle hypotheses and the theory of business investment, both of which are closely tied to the portfolio analysis in the preceding chapter. In Chapter 4, the functions of the capital market are described in terms of intermediation and asset mutation effects. Here Moore gives the reasons for financial innovations, the distinction be-

tween direct and indirect finance, the role of the financial market in the allocation of resources, and economic growth and stability. Chapter 5 takes up a general equilibrium analysis of asset prices by utilizing the theoretical tools advanced in prior chapters. The temporal versus full equilibrium, the speed of adjustment between the desired and actual stocks and the term structure theory all find a place in this chapter. While Chapter 6 explains the behavior of commercial banks in terms of portfolio management under uncertainty, Chapter 7 demonstrates the similarity and the difference between bank and nonbank intermediation and goes on to discuss the equilibrium volume of such intermediation with or without government regulation. In Chapter 8 the book culminates with what it ultimately wants to bring out, namely, the effects of monetary changes on real economic variables in both static and dynamic frameworks. Following in Chapter 9 are the theoretical analyses of alternative monetary instruments and policy techniques in pursuing economic objectives. The book closes with a special topic on equity finance in the final chapter.

In the preface the author asserts that most introductory texts in the economics of money and banking are too long on money and banking and too short on economics. The basic objective of the book, therefore, is to present an analytical framework with which the financial and real behavior of the economy can be analyzed. The author largely succeeds in this objective. Throughout the book, he introduces recent theoretical tools and analytical diagrams (some of which have not yet been incorporated into other textbooks) for tightening the whole structure of the book into a unified theoretical framework. To mention a few highlights in the book, it contains an unambiguous discussion of asset management under uncertainty; a simple but lucid explanation of recent consumption function theories and their implications for asset management; a clear treatment of the portfolio as well as the wealth effect; a competent presentation of bank versus nonbank intermediation and even an analysis of alternative monetary controls with the "inside" and "outside" money distinction. Although the book is theoretically oriented, it occasionally throws light on such policy issues as regulations on bank deposit rate (p. 257) and the effects of nonbank intermediation (pp. 205-10). This undoubtedly helps students to understand how one can draw policy implications from the theoretical analysis in monetary economics.

Although the book is well written, the readers should exercise caution. The author presents arguments and conclusions of many different writers without many references, even though some are listed at the end of each chapter. Also, the author here and there carries forward his own arguments and conclusions without explicitly introducing the assumptions involved. For example, he attempts to show that with inside money only, even a laissez-faire banking system determines the equilibrium nominal quantity of money (p. 195). The author, however, fails to mention that this conclusion holds true only in partial analysis rather than in general equilibrium analysis. In another place, he proposes to show non-neutrality of money under neo-classical and Keynesian worlds with static assumptions (p. 219). But he proves the proposition by arguing that changes in the money stock (unfortunately not distinguishing inside-outside money) will bring about a shift in the composition of output and the path of capital formation and hence will result in a shift in the marginal

efficiency of capital (pp. 224-25). This is a dynamic rather than a static theoretical argument. Such weaknesses on occasion, however, are not crucial defects. A competent instructor can easily supplement them wherever necessary.

In general, this book is a well-organized and scholarly-written book that students in monetary economics should find stimulating. The fluent literacy running through the book may guide independent readers in grasping recent developments in monetary theory and policy.

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### Public Finance; Fiscal Policy

*The Taxation of Personal Wealth.* By ALAN A. TAIT. Urbana: University of Illinois Press, 1967. Pp. 238. \$7.50.

Alan A. Tait (Dublin University) sets himself the task of establishing a far more important role for wealth taxation in the fiscal system of the contemporary state than such levies have anywhere attained in modern times. While the evidence of history suggests the task is Herculean, Professor Tait is undismayed by the obstacles of analysis and technical complexity and genially proceeds to build a case for a three-part tax system, including an income tax, a pay-as-you-accumulate tax (P.A.Y.A.) and a lifetime tax, on the shifting sands of equity and social-political criteria.

Tait asserts early on in his text that the normative case for redistribution of wealth by wealth taxation cannot be made by economic analysis, and this reader, for one, is abundantly satisfied that he has proved the point. Tait ticks off a number of the standard arguments concerning the occasion for altering the distribution of wealth on so-called socioeconomic and political grounds, but concludes that they are useful only if one begins with preconceptions of a desirable state of affairs. On the other hand, he casts up an argument for wealth *taxation*, rather than wealth *redistribution*, on equity grounds, maintaining that if the equity rule of like taxation of individuals in like circumstances and differentiated taxation of individuals in unlike circumstances, properly weighting the differences, is to be observed, then income taxation must be substantially supplemented by wealth taxation, since income alone does not adequately measure similarity or difference in circumstance. This inadequacy, of course, has often been noted by both friend and foe of income taxation, but it does not follow that wealth taxation is uniquely the type of levy to employ to assure equity in this sense, or, indeed, that any tax can contribute very much in this respect. As Tait's discussion suggests, determination of the relevant circumstances and assessment of differences therein are sticky problems; equity, like beauty, is in the eyes of the beholder.

Having distinguished between the two cases for wealth taxation, Tait asserts that "the principal justification for wealth taxes is to insure equity through the tax structure." But the ensuing discussion also stresses heavily the amelioration of inequality in the distribution of wealth, taking off from the proposition that, in the absence of explicit public measures to the contrary, this distribution is likely to become more unequal through time. The analysis



Tait offers in coming to this conclusion leaves much to be desired. It is based in part on an implicit assumption about the nature of the shifts in the production function over time in the modern industrial society and the effects on income shares of automation (which Tait defines as "machines replacing man"). It is surely a strange line of reasoning Tait pursues to go from an increase in the capital-labor ratio to a decrease in the labor share of national income. Some empirical investigation (of which the book offers very little) to this point would have shown Tait that capital-labor ratios rose during the postwar years along with increasing labor shares of income in the United States and in Northwest Europe, where, presumably, automation flourished. (See Edward F. Denison, *Why Growth Rates Differ*, Washington, 1967.) But quite apart from the lack of realism in the argument, the likely change in income shares which Tait suggests has no necessary implication for the shape of the distribution of wealth by wealth level.

The character of Tait's analysis in this area is indicated further by his contention that the wage share of national income may be reduced "... by the possible decline in the marginal propensity to save of those whose wealth holdings grow bigger." The consequences of any such development, according to Tait, would be a *decrease* in the rate of growth of the capital stock, an *increase* in the capital share of national income, and an *increase* in the wealth of large wealth holders relative to that of small wealth holders.

Argument of this sort does little for one's expectation about what is to follow in the analysis of specific forms of wealth taxation, leading up to Tait's proposal for a three-tier tax system. In fact, however, Tait does a quite commendable job of laying out some of the standard arguments in this area, and his own improvisations are often useful as well.

Tait reserves discussion of the effects of personal wealth taxes for his penultimate chapter, and casts this discussion in the Musgrave differential incidence format. No effort is made explicitly to assess the welfare or excess burden effects of the levies he considers, and the analysis that is provided leads Tait to conclude that "overall, there are no determinate statements that can be made about the effects of wealth taxes." Given his focus on equity consideration, this is a comfortable conclusion to arrive at, imposing no analytical constraints against his P.A.Y.A. tax proposal.

The P.A.Y.A. proposal seeks a complete integration of income and wealth taxation to achieve equity among taxpayers currently and over time. (Tait's concern with the latter dominates the discussion in much of the book, and is responsible for many of the complications which Tait himself identifies in his scheme; the reader is likely to come away with the conclusion that a very small tail is wagging a very large dog.) The tax base would consist of gross current wages, salaries, and capital money income plus accruals (gifts, legacies, etc.), plus the income in the current period attributable to current accruals, i.e. capital gains and an imputed yield for "security" from holding wealth, less exemptions for the current period. From the current year tax liability on this base, previous cumulated tax payments would be deducted. An ultimate reconciliation of lifetime accrued tax liability and actual tax payments would be made, either at death or at retirement.

Tait acknowledges and attempts accommodations for the difficulties of im-

plementing his proposal. However remote his approach might appear (the Carter Commission recommendations for Canada, incidentally, include a number of provisions that move in this direction) and however unsatisfactory the analysis leading to his major conclusions might appear to many readers, Tait's discussion nonetheless provides a useful inventory of the important issues in this area of tax policy.

NORMAN B. TURE

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*An Introduction to Public Finance.* By H. E. NEWMAN. New York: John Wiley & Sons, 1968. Pp. viii, 677. \$9.95.

According to the author the book is intended as a text for a one-semester public finance course, based on an understanding of the principles of economics. The material is organized as follows. After the introductory chapter there is a discussion of the institutional framework relevant to public finance, with a particularly interesting description of constitutional and other limitations on the taxing power of the different governments (federal, state and local). The macroeconomic aspects of public finance are presented in the three succeeding chapters. The first, on fiscal policy, briefly touches on a wide range of topics including monetary policy, market policy (promoting competition in all markets), the expenditure, tax, and balanced-budget multiplier effects, built-in flexibility, taxes to encourage investment and consumption, and secular stagnation and exhilaration. A chapter on the political and administrative problems encountered in putting fiscal policy into practice, and a review of policy since 1946, is followed by one on the public debt. In view of the fact that this chapter purports to discuss current as well as historical attitudes towards the national debt, it is strange that it contains no mention of the (widespread) current view that a burden is imposed on future generations when there is a reduction in capital formation attributable to debt financing.

The remainder of the book (excluding the final two chapters) is devoted to the standard microeconomic aspects of public finance. That is, the concepts of shifting and incidence are defined, and the benefit and ability-to-pay approaches to taxation discussed. A detailed account of different possible bases for taxation including personal and corporate income, transactions, property, and estates and gifts accounts for over one-third of the text. This discussion involves an analysis of the various taxes in terms of their administrative feasibility, their incidence, and the benefit and ability-to-pay criterion. The historical development of existing taxes is traced in detail. In the final two chapters intergovernmental fiscal relations are discussed at length while only 13 pages are devoted to the topic of economic growth—with emphasis (for reasons which are not clear) on a discussion of the familiar structural-versus-demand unemployment controversy.

By far the most interesting feature of the book is a detailed presentation of the historical, legal and administrative aspects of public finance. Indeed one of the author's stated objectives is to achieve a "proper blending (of economic theory) with historical perspective and a certain amount of political pragmatism." The analyses of the federal government's taxing power and its limitations in relation to the Constitution, and of the states' taxing powers in terms

of inherent sovereignty are enlightening. A brief historical sketch, together with a discussion of relevant legal cases, provides an interesting and informative introduction to almost every topic covered. The existence of an index of over 100 "legal cases" attests to the emphasis throughout the book on the legal aspects of public finance.

On the other hand, the weak point of the book is its cursory treatment of the macroeconomic aspects of public finances. Fewer than 50 of the 660 pages are devoted to the analytics of countercyclical fiscal policy, and indeed the coverage of this important topic is probably less comprehensive than in most principles courses in macroeconomics. There is, for example, virtually no discussion of the effects of government expenditure or tax policy in terms of the familiar income determination model, or in terms of the IS-LM analysis, while the multiplier discussion is restricted to the simplest of static cases. In a modern public finance text one might hope to find a substantial treatment of such topics as fiscal drag, the full-employment surplus, dynamic multipliers and at least some mention of recent developments in the field of macroeconomic model building—such as fiscal policy simulation. A reporting of other recent pertinent empirical results, including for example estimates of the effect of accelerated depreciation on investment, estimates of the lags in fiscal policy, or even rough calculations showing the order of magnitude of current expenditure and tax multipliers would add greatly to the presentation.

In recent years there has been a great deal of interest expressed among economists and others in the possibility of extending the positive income tax to include taxation at negative rates. Regrettably the author relegates his discussion of the negative income tax and income maintenance in general to a footnote.

In conclusion this book is recommended for those undergraduates who are particularly interested in the legal, historical and administrative aspects of public finance. It is not recommended for those interested in macroeconomic aspects.

TERENCE J. WALES

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### International Economics

*The Economics of Interdependence: Economic Policy in the Atlantic Community.* By RICHARD N. COOPER. New York: McGraw-Hill, 1968. Pp. xiv, 302. \$10.95.

"The central problem of international cooperation—and of this book—is how to keep the manifold benefits of extensive international economic intercourse free of crippling restrictions while at the same time preserving a maximum degree of freedom for each nation to pursue its legitimate economic objectives."

Reconciling internal full employment (without inflation) with external payments balance is a principal theme. The avoidance of competitive trade restrictions is another. In addition, the domain of the international corporation has outrun national governmental jurisdictions with consequent problems in

the fields of taxation and regulation of direct investments. In dealing with these issues, and many others, Professor Cooper has an acute quantitative awareness of the rapidly changing nature of modern technologies and a deep appreciation of the way in which North Atlantic economics institutions—IMF, OEEC, EPU, etc., and the multiplicity of *ad hoc* relationships among central banks—have evolved in the postwar period. Thus he provides a nice balance between theoretical sharpness and concern for the institutional environment within which decisions must be made. For this reason, it would be an ideal capstone for courses in International Economics, and its nontechnical nature makes it easily accessible to international specialists of all kinds.

He begins with a concise international monetary history of the postwar period. For example, he shows how the IMF more or less opted out of being a liquidity source for developed European nations in the 1940s and 1950s and became, principally, a short- and medium-term lender to underdeveloped economies. Thus European countries developed in its place intra-European monetary institutions such as the EPU and also relied on official U.S. loans or the New York money market to meet their liquidity needs. In the middle 1960s, the IMF has moved towards playing a more central role, but it is by no means the dominant provider of international liquidity that its founders intended.

The increasing similarity of production patterns among countries (and among American states) and the decline in natural-resource based trade are both emphasized by Cooper. He concludes, somewhat dangerously albeit with many qualifications, that growing two-way trade within industrial classifications may signal something of a decline in the gains from trade. In addition, falling transportation costs (as well as lowered trade barriers) have increased the sensitivity of trade flows to internal economic disturbances. He suggests these developments make the need for external balance-of-payments controls more pressing, and it is this concern with interdependent national policy making that is the core of his book.

Cooper is aware of arguments for increasing the automaticity of balance-of-payments adjustment by removing it from the sphere of conscious national policy. The optimum currency area idea of having floating exchange rates between blocs loosely related in foreign trade together with full monetary and financial integration and fixed exchange rates *within* such blocs is examined. He discusses proposals for increasing the bands within which exchange rates could fluctuate (presumably with the U.S. dollars as the point of reference). Essentially, however, he considers all these to be outside the realm of immediate political feasibility. As a matter of "practical economics," he concentrates on the least noxious external control devices coupled with provision of international liquidity as instruments for preserving national autonomy in internal resource use.

He views controls on capital movements to be acceptable for insulating domestic monetary policies from each other—provided that international consultation and agreement are achieved prior to their imposition. The increasing web of capital controls being imposed by the U.S. government—and, indeed, the capital controls which have been exercised for a long time by most European governments—suggest his viewpoint is widely shared. Cooper's strong de-

sire to preserve national autonomy in internal resource use stems in part from the needlessly high levels of unemployment in the United States in the late 1950s and early 1960s. Similarly, there were unwanted "imported" inflations in Europe in the same period. To him, capital controls seem to be one answer, with increases in official international reserve creation—Special Drawing Rights—another complementary answer, although he is by no means completely happy with either.

If the reviewer may mention one note of discontent with an excellent book, it is the implicit acceptance that national governmental authorities are really very acute individuals who can be trusted to intervene in a stabilizing fashion after carefully weighing all the pros and cons with their neighbors. Recent performances by banking and fiscal authorities in North America and Europe are not overly reassuring. More automaticity through flexible exchange rates under the optimum currency area argument should possibly not be put outside the realm of practical foreign policy. Additionally, international consultation cannot paper over mutually inconsistent payment goals—whether arising out of arbitrary accounting practices or the desire to build up liquidity.

Instead of having a conscious balance-of-payments policy with attendant capital restrictions and the like, the United States could deliberately play a passive role with a purely residual balance-of-payments policy. Other countries could then pursue whatever balance-of-payments goals that they wished—using any exchange rate system vis-à-vis the U.S. dollar which they wanted. This role is highly complementary with the U.S. dollar being international money—assuming effective gold demonetization. The United States could then concentrate on stabilizing *internal* policy alone and forget about international consultations. Providing a stable balance wheel for the world economy is probably the most internationalist policy the United States could follow. It would imply the removal of all recent restrictions on capital flows and tourist travel. In short, it would require the United States to consciously adopt an independent but well-defined economic policy to which other countries could accommodate themselves.

Excessive preoccupation with overseas problems leading to an excessive multiplication of domestic policy goals may simply introduce uncertainty and confusion into U.S. policy making. The world then loses a badly needed stabilizing influence. It may be incorrect to see the standard textbook conflict between internal stability and external payments "balance" in the case of the United States with its highly dominant position in the world economy.

RONALD I. MCKINNON

*Stanford University*

*Capital Markets in Atlantic Economic Relationships.* By SIDNEY E. ROLFE. Boulogne-sur-Seine: The Atlantic Institute, 1967. Pp. 87. \$2.00.

*Capital Markets Study: Volume I, General Report.* Committee for Invisible Transactions. Paris: Organization for Economic Co-operation and Development, 1967. Pp. 261. \$6.00.

The study of international capital markets was largely neglected in the postwar period in spite of the lessons of history which demonstrated their im-

portant role in the interwar period in contributing to international instability and the eventual collapse of the international monetary system. This neglect has been eliminated recently by the publication of two major studies of European Capital Markets, one by the OECD reviewed here and the other by the European Economic Commission.<sup>1</sup> Dr. Rolfe's study for the Atlantic Institute is based largely on the factual findings of the two Reports. The three Reports come to essentially the same empirical findings and conclusions, and make similar recommendations.

The Atlantic Institute Study is by far the most readable, freed as it was from the restraint of government approval and protocol. The others require some reading between the lines. Dr. Rolfe states the problems and alternatives before the international community clearly and directly. His volume should suffice for most readers who do not wish to delve into the details. It is also useful to the specialist in helping him obtain a bird's eye view of the problems confronting the creation of an European capital market before he plunges into the more voluminous OECD and EEC documents. The OECD Report itself is Volume I of a four-volume report summarizing three volumes of detailed studies.<sup>2</sup>

The OECD and EEC are pledged to liberalize capital movements, and the EEC eventually to eliminate entirely discrimination based on nationality or residence in its member countries. It is evident, however, that few countries have accepted as self-evident the goal of unrestricted capital movements, either within a limited group such as in the EEC or OECD or over a wider area. This is contrary, for example, to the wide agreement obtained on the goal of unrestricted current transfers. The basic reason for this is that unrestricted capital movement restricts national sovereignty over monetary and fiscal policy. Therefore the general question of the liberalization of capital movements is intimately bound up with the question of the international harmonization of monetary and fiscal policies which in turn depends upon wider agreement upon the policy mix that is to be employed in dealing with problems of business fluctuations and economic growth. So in many ways the discussion of developing international capital markets is putting the cart before the horse. All three of the Reports reviewed here recognize this but nevertheless come to the conclusion that the future need for capital is urgent and the present international market, although it has functioned well in the past, largely due to the services provided by New York and London, is unlikely to be adequate for the future. The OECD and EEC therefore decided to treat the problem symptomatically rather than await the more basic agreements that are necessary for full success.

This procedure, defective as it is, can be forgiven. If agreement on fundamental principles had to be attained before starting on any international cooperative venture, few exercises would ever get past this stage. Less easy to understand is the fact that, with the possible exception of Germany, none of the

<sup>1</sup> *The Development of a European Capital Market*, Report of a Group of Experts. Brussels: European Economic Commission 1966.

<sup>2</sup> Vol. II, *Formation of Savings*; Vol. III, *Functioning of Capital Markets*; Vol. IV, *Utilization of Savings*.

countries studied have developed a policy toward their *national* capital markets and, as the OECD notes, their goals cannot be inferred from empirical observation. The financing policy of most countries appears to be residually determined after all other economic policies have been implemented.

The basic problem confronting Europe today is that corporate profits and other internally generated savings are declining, making self-financing more difficult. As the profit share has declined, the wage share has risen and therefore if present rates of capital formation are to be sustained, personal savings must be increased and recaptured through capital markets. A fundamental obstacle to the development of European capital markets is that a major portion of government expenditures is financed through the limited capital market facilities rather than by taxation. The question for many countries is becoming private growth or public borrowing. As Rolfe points out, most past government borrowing in the private capital market was made without full consideration of its consequences for the private sector. Government behavior did not reflect an imperfect market—it created one.

The Reports abound with numerous useful suggestions for the improvement of existing capital markets. They emphasize the importance of the development of contractual savings institutions such as life insurance companies in providing long-term capital to business. However, because of past and present inflation, and general financial insecurity, it has been savings in the form of acquiring liquid short-term financial assets that has been growing faster than any other form.

To deal with these problems, the Reports suggest that the functional and geographic compartmentalization of financial institutions need to be broken down and national capital markets created. Institutions need to be developed to guarantee the liquidity of long-term lenders.

The role that the United States and the United Kingdom played in providing an international capital market is declining, as the Continent increasingly rejects the gold-dollar standard without providing a suitable substitute. The result is that the only international capital market which exists in Europe today is the Euro-dollar market. The Euro-dollar market, however, is a reversed-development plan—it receives the bulk of its funds from less developed areas for investment in Europe.<sup>3</sup> In addition it draws private holdings of dollars into official reserves to the extent that the borrowers want European currencies rather than dollars, which further aggravates the U.S. gold drain.

The question of the advisability of a centralized versus a decentralized European capital market is sidestepped by all three Reports—no one wishes to make the Judgment of Paris. The EEC diplomatically suggests that, contrary to past experience, the capital markets in Europe can develop without the creation of a dominant center.

There is no substitute for an European capital market—the Reports under review offer none. Nonetheless, the immediate prognosis for the creation of one is poor. Numerous political hurdles both in Europe and the United States

<sup>3</sup> Cf. D. WILLIAMS. "Foreign Currency Issues on European Security Markets," *IMF Staff Papers*, March 1967, p. 61.

must be surmounted. Once this is accomplished, the Reports and their recommendations will provide an excellent starting point for the creation of a truly European Capital Market.

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*Imports of Manufactures from Less Developed Countries.* By HAL B. LARY.  
New York: National Bureau of Economic Research, 1968. Pp. xvii, 286.  
\$8.50.

In this well-written and informative book, Hal B. Lary examines a topic of vital importance to the growth of the less developed nations: their export of labor-intensive manufactures. Lary concurs with the general thesis of UNCTAD that the developing nations must significantly expand their export of manufactures to avoid stagnation due to the impending "foreign exchange gap."

Taking essentially a Heckscher-Ohlin view of the world, Lary sets out first to identify and then to summarize the trade in labor-intensive manufactures and finally to predict the future growth of this trade. It is the identification of labor-intensive manufactures which occupies the major part of the book.

This identification procedure consists of using U.S. industrial data to determine which industries in the United States are labor intensive, and showing that this pattern or ranking of industries according to factor intensities closely approximates those found in other nations, including the less-developed countries having quite different factor-price ratios. In short Lary's conclusion is that factor-intensity reversals are, contrary to Minhas, "much less important empirically than . . . interesting theoretically."<sup>1</sup>

As basic data, Lary employs value-added by manufacture per employee as his overall measure of capital intensity. This aggregate is subdivided into two parts, a wage and salary component and a residual component. The first is then shown to be a good proxy for a return to human capital within the industry since there exists a significant correlation between "wage value-added" and other measures of skill across U.S. industries. The second component, "non-wage value-added" is similarly shown to be a decent proxy for the return to physical capital. Again the method is to show the significant relationship between this component and other measures of the stock of physical capital.

Lary believes his approach to the identification of factor proportions to be superior to other methods in that it permits "a unified treatment of both physical and human capital" and enables the researcher to tap similar data from the national censuses of manufacture of other countries.

Lary then ranks U.S. industries on this basis calling those in the lower ranks "intensive in the use of relatively unskilled labor." He ignores the factor intensities of intermediate inputs "on the assumption that [they] are ubiquitous or readily transportable." This assumption is a weak link in his analysis in light of the findings of Arrow, Chenery, Minhas, and Solow that: "the average price

<sup>1</sup> P. A. Samuelson, "A Comment on Factor Price Equalization," *Rev. Econ. Stud.*, 1951-52, 19(2), pp. 121-22.



of purchased inputs in [ten Japanese manufacturing] sector ranges from 0.93 to 1.70 of their cost in the United States, which more than makes up for the lower cost of the factors used directly. An adequate explanation of the differences in relative prices [and hence factor endowments] requires an analysis of total factor use rather than direct use by itself."<sup>2</sup>

Whether the U.S. industrial ranking by factor intensities holds for other countries depends upon the validity of the "strong-factor-intensity" hypothesis. Lary consequently is forced to confront Minhas who has found factor-intensity reversals to be "empirically important" in his comparative study of factor use in U.S. and Japanese industry.<sup>3</sup>

Lary, in attacking Minhas, draws upon the works of Hufbauer and Ball<sup>4</sup> both of whom by the judicious exclusion of one or two industries have shown how Minhas' rank-correlation coefficients can be altered so as to support the "strong-factor-intensity" hypothesis. But this is rather beside the point since Japan today stands toward the middle of the range of factor-price ratios, not at the lower end. Until the appropriate tests are applied to the data of such countries as South Korea, Taiwan, and Hong Kong, which export considerable quantities of manufactures, we will remain in doubt as to the actual identification of labor-intensive manufactures. My own rough calculations indicate that the relevant range of wage-profit rate ratios today is approximately double that used by Minhas, who, based on data from the early fifties, referred to a range of \$1100 to \$24,000 (\$250: 22 per cent; \$3600: 15 per cent). In 1965 the range was close to \$1300 to \$43,000 (\$300: 22 per cent; \$5600: 13 per cent). This, of course, increases the likelihood of reversals.

Next Lary undertakes three cross-country comparative studies of industrial factor intensities each using a different level of aggregation and number of countries. Each tends to support the author's use of the U.S. data in identifying labor-intensive manufactures.

The products so identified are then subjected to a detailed commodity by commodity and country by country analysis. The total value of this trade in the total exports of the less-developed countries amounted to only \$2.4 billion, or about ten per cent of the total exports of the LDCs. But its rapid growth, 11 per cent in 1965, and its uneven distribution makes this category of trade most interesting and potentially of major importance to the less-developed world.

Lary concludes with a chapter on commercial policy in which he touches on effective tariff rates, nontariff barriers, and the issue of tariff preferences for the developing nations.

Overall, the book represents an important nexus among international trade theory, empirical trade-pattern studies, and developmental policy. As such it is required reading for trade and development economists. Although one may

<sup>2</sup> K. J. Arrow, H. B. Chenery, B. S. Minhas, and R. M. Solow; "Capital-Labor Substitution and Economic Efficiency," *Rev. Econ. Stat.*, Aug. 1961, p. 244.

<sup>3</sup> B. S. Minhas, *An International Comparison of Factor Costs and Factor Use*, Amsterdam 1963, p. 40.

<sup>4</sup> Gary Hufbauer, *Synthetic Materials and the Theory of International Trade*, Cambridge, Mass. 1966, Appendix B. David S. Ball, "Factor Intensity Reversals in International Comparison of Factor Costs and Factor Use," *Jour. Pol. Econ.*, Feb. 1966, 74, pp. 77-80.

be somewhat troubled by the author's theoretical infrastructure, the book remains an extremely valuable contribution on one of the most important problems confronting the developing nations. After all, if Lary's book had to await the definitive answer to the Leontief paradox few of us would be around to read it.

DONALD R. SHERK

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*The Economics of Foreign Aid.* By RAYMOND F. MIKESSELL. Chicago: Aldine Publishing Co., 1968. Pp. xv, 300. \$7.95.

This book is one of several to have emerged in the past few years offering an economic analysis of foreign aid, as distinguished from economic development. Others include John Pincus' study for the Council on Foreign Relations, H. G. Johnson's study for The Brookings Institution, and *International Aid* by I. M. D. Little and J. M. Clifford. The focus of each differs somewhat, with Pincus and Johnson, for instance, giving rather heavy weight to trade policies as a vehicle for economic assistance. Of all these works, Mikesell's comes closest to being a text-book, offering a comprehensive review of the work of others but providing little new in the way of empirical or theoretical analysis. Instead, he brings his sound and experienced judgment to bear critically on the theories underlying the calculation of aid requirements and the practical criteria used in the granting of aid.

Following an introduction on the diverse objectives of foreign assistance, Mikesell reviews briefly but comprehensively the various theories of—or rather schools of thought about—economic development. He then takes up in turn theories about the contribution of external assistance to economic development, calculations of global aid requirements, problems of servicing growing external debt, criteria for granting foreign aid, the merits of alternative forms of aid, and the burden of foreign aid on the donor countries. The book ends with a chapter summing up the author's own views and offering suggestions to guide foreign aid policies in the future. The chapter offering to a wider readership some of the technical work that has been done on the problems of servicing a growing external debt is particularly welcome, since these problems are likely to loom more important in future relations between developed and less developed countries than they have in the past.

Mikesell's book is representative of the strong and healthy movement, among those concerned with aid to less developed countries, from emphasis on a shortage of capital or foreign exchange to the need for transforming social and economic structures and policies—a shift from gap-filling to structure-changing. He discusses the various saving- and foreign exchange-gap models of development, but is highly critical of their exclusive emphasis on one or two scarce resources, of the rigid parametric assumptions underlying the models, and of the use of such models for estimating total aid requirements, or as the basis for granting aid to individual countries. Instead, he underlines the "inducement effects" of foreign aid, the use of external assistance to persuade recipient countries to shed rigid practices inherited from the past and to adopt agricultural, fiscal, commercial, and other policies conducive to growth. "The

function of concessionary aid is not primarily to supplement the resources of the recipient, but rather to help the recipient mobilize its own resources . . ." (p. 157).

Emphasis on the inducement effects of aid poses its own problems, of course. Not least is that it involves asking the public in the donor countries to provide funds, not to help the less developed countries do something they *couldn't* do without outside help, but to bribe them into doing something they *wouldn't* do without outside help. Moreover, granting aid for its inducement effects may set up a perverse incentive for less developed countries to hold back on desirable programs in the expectation that donors may be expected to pay them to undertake such programs. Mikesell is well aware of the need to incorporate strong "self-help" incentives, and suggests (p. 152) the rule of thumb that donors provide no more than one-fourth of the financial resources for any particular program.

It is implicit in Mikesell's discussion that financial assistance should generally be in the form of loans rather than grants, and he suggests at one point (p. 268) that concessional loans should carry no interest charge for a period that should generally not exceed ten years, at which time conventional interest rates would be applied. This would put the aid recipients on notice that they had better shape up, and quickly!

Mikesell favors unlimited access by less developed countries to the major capital markets at conventional terms, just as Canada can borrow freely in the United States. Since access by less developed countries to the U.S. capital market is unrestricted, this remark would seem to be aimed primarily at the European countries, many of whom control access to their capital markets. But it underrates the difficulties that arise when standards of "credit-worthiness" in the financial community are at sharp variance with performance conducive to economic development—for example, land reform or tax reform.

The weakest part of the book is the discussion of aid in other guises, such as preferential trading arrangements or price-raising commodity agreements. Mikesell fails to offer even a sketchy discussion of the possible contribution of trade preferences to development (little, in my view, but it is an important issue deserving serious discussion), and of how the benefits of "aid" in this form as compared, say, with capital assistance hinge critically on the nature of economic development. Mikesell recognizes that solid export performance is a prerequisite to sustained economic growth, but he apparently gives export promotion a low score in terms of transforming attitudes and institutions, transformations that are at the core of his eclectic model of development. And his normally critical faculties fail him when it comes to a discussion of arrangements for compensatory finance, where he confines himself to a brief summary of recent proposals. Finally, he fails to point out the rather frightening implications for future debt servicing, discussed in one part of the book, of aid-tying, discussed in another.

All in all, however, this book offers a solid and thoughtful discussion of the economics of foreign aid, and it will be a welcome addition to the library of those who must either teach about foreign aid or administer it.

RICHARD N. COOPER

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*Japan's Dependence on the World Economy: The Approach Toward Economic Liberalization.* By LEON HOLLERMAN. Princeton: Princeton University Press, 1967. Pp. xv, 283. \$7.50.

This book begins with some good and some questionable statistical analyses of postwar Japanese industrial growth and its relationship to foreign trade. The last half of the book describes policy instruments for controlling trade flows on both the import and export sides, and for controlling the banking and financial systems. The author is evidently well acquainted with Japanese scholars and has had numerous informal contacts with businessmen and members of various government ministries. His description of Japanese policy makes fascinating reading.

The statistical prelude attempts to measure Japan's development by using indicators other than per capita real income. Unfortunately, much of the data applies to the middle 1950s in an economy which has rapidly changed since then; and the presentation of a diverse set of development indicators, e.g., fertilizer use and dependence on raw materials imports, suffers from the fact that they can be expected to vary widely apart from the level of development. Nevertheless, he notes apparent imbalances in the Japanese economy as it ranks high on some indicators and low on others.

He tries to explain export development by looking for correlation with such things as productivity change in different industries and, surprisingly, doesn't find any. (As he notes, relative productivity change vis-à-vis the rest of the world might give more explanation.) He finds a weak positive secular correlation of export expansion with output expansion across industries, which is not surprising since exports are one component of output. From a short-run cyclical point of view, however, he finds that aggregate output and aggregate export expansion are negatively correlated. This reflects the effectiveness of tight money policies in expanding exports. Japanese exports appear highly responsive to changes in supply conditions.

There is a peculiar digression on the importance of increasing the share of value added in gross output for factory shipments in different industrial classifications. Apparently, Hollerman and some Japanese government officials consider increasing value added per shipment to be an indicator of greater development and are somewhat unhappy with the fact that it seems to be declining slightly in recent years. In fact, the share of value added is no indicator of development and, indeed, a declining share might represent increasing specialization in the economy. Alternatively, a declining share may result from technical change which simply permits one to get more for less from the primary factors of production, if one makes appropriate assumptions about their elasticity of substitution with raw materials.

Hollerman views exports as the key restraint on future Japanese economic growth. Although exports are only about 12 per cent of national income, he concludes rightly that the economy's trade dependence is much greater than it seems because of the essential nature of all its imports. He notes some interesting characteristics of the way in which the Japanese run this key sector. For example, in 1963 Japanese foreign currency reserves of \$2.183 billion were less than short-term liabilities to foreigners of \$2.559 billion. The reserves themselves were equal to only three or four months' imports. Japanese

short-term private assets were \$.942 billion. The need for a sensitive external payments control mechanism is evident.

The author emphasizes the short-term nature of the Japanese financial structure. In 1963, long-term external debt was only slightly greater at \$3.350 billion than external short-term liabilities. Financing of domestic fixed investment is sometimes done at short term by continually rolling over bank loans, domestic or foreign. Firms provide short-term supplier credits to each other as a principal vehicle of finance. "As of September 1963, the net worth of Japan's main manufacturing corporations amounted to only 29 per cent of their total liabilities—a sharp relative decline from 1955 when the ratio had been 40 per cent. Borrowed capital has been supplied mostly by the commercial banks, which extend long-term loans for fixed assets as well as working capital funds" (p. 174). In addition, gross investment is very large, constituting 41 per cent of Gross National Expenditure in 1962. Thus, the real size of the commercial banking system is indeed large in Japan with the private sector eschewing self-finance and being heavily dependent on external bank credit.

What accounts for this large real size of bank finance? In contrast to many underdeveloped countries, the Japanese government has not stocked the banking system with its own debt, and reserve requirements with the central bank are virtually trivial—between  $1\frac{1}{2}$  and 3 per cent of deposit levels. Rediscounting of private paper is the principal technique for expanding the money supply. "The commercial banks themselves are also in a vulnerable position, for their loans and discounts have been approximately equal to their total deposits since 1950. This is known as the 'overloan' situation" (p. 174). From its own surpluses, the government is an important depositor in the commercial banks. Essentially, the enormous flow of public and private saving in Japan is decentralized through the intermediation of the banking system. Avoidance of the inflation tax and the deposit of government surpluses have been important factors in this huge financial growth.

Although the financial system is highly decentralized in that private or government self-finance is not very important, paradoxically it is a highly effective instrument of centralized control by the Bank of Japan. A cutback in rediscounting by the tightly stretched commercial banks induces an immediate and significant credit contraction which has ramifications in all portions of the economy. Aside from its successful policy of permitting long-run growth in the real stock of money, the government's principal policy objective has been the short-term stability of the foreign exchanges. Tight money has been used to overcome balance-of-payments difficulties accentuated by the relatively limited foreign exchange holdings of the government. Both imports and exports have promptly responded to credit contractions with additional help from increased bank borrowing abroad.

Foreign pressure by GATT and the OECD and this effective monetary control instrument have been important in the overall liberalization of Japanese imports of goods and services, as Hollerman discusses in detail. The Japanese now claim that about 93 per cent of their imports are "liberalized"—that is, they enter without being subject to quantitative restrictions. Unfortunately, it is still very difficult to evaluate the 93 per cent figure, as imports which are

completely prohibited would not have any weight in the index. There remains a web of informal government surveillance of imports which is difficult to evaluate.

Japan also has extensive "organization" of its exports trade in certain respects (p. 214). There is the well-known government-to-government agreement to limit cotton textile exports. In addition, exports are sometimes controlled to offset threats from protectionist legislation abroad. Finally, exports are sometimes controlled to upgrade their quality. Notwithstanding all this, Japanese exports still face heavy discrimination in the markets of Western Europe, unlike those of the United States (p. 205). Apparently, Europeans have a much greater proclivity to discriminate on the basis of country of origin than does North America. Much Japanese import liberalization under GATT and the OECD is economic diplomacy designed to remove discrimination against its exports.

Hollerman discusses the restrictive policy against foreign direct investments. Of the \$3.6 billion of long-term foreign capital entering Japan from 1949 to 1964, only 5.9 per cent took the form of equity capital with management participation (p. 262). Of this, only a negligible \$10 million was investment in wholly owned branches or subsidiaries of overseas corporations. Another \$213 million went into management participation stock where Japanese generally maintained majority control. The Japanese system of "administrative guidance" is certainly effective in barring foreign enterprise, with ministerial control being extremely detailed. This stands in great contrast to the enormous American direct investments in Europe, Canada, and throughout much of the underdeveloped world. Apparently, learning by doing means just that in Japan, with Japanese nationals rather than large international corporations being the students.

The implications for the structure of Japanese industry are marked since the Japanese government encourages the licensing of overseas techniques by purely Japanese firms. Essentially, the economy may forego some immediate gains in access to foreign know-how through its investment policy in return for acquiring the skills to develop its own technological base. In addition, there are no inhibitions on exports which might otherwise compete with the output of "parent" companies. Many of the barriers to foreigners arise out of "cultural" considerations; nevertheless the painful reassessment of American direct investment in Europe by J.-J. Servan-Schreiber in *The American Challenge*, suggests that a closer look at Japanese economic policy is warranted. Professor Hollerman's book is a great help to scholars making this examination.

RONALD I. MCKINNON

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*The Global Partnership—International Agencies and Economic Development.*

Edited by RICHARD N. GARDNER AND MAX F. MILLIKAN. New York: Frederick A. Praeger, 1968. Pp. vii, 498. \$9.50.

The twenty essays in this book may be divided roughly into two groups: those that deal specifically with the activities of international and regional de-

velopment assistance agencies, and those that are concerned with particular development problems and the role of external agencies in dealing with them. The former include essays on the U.N. Economic and Social Council and related agencies such as the U.N. Conference on Trade and Development (UNCTAD), by Walter Kotschnig and Richard Gardner; the General Agreement on Tariffs and Trade, by John Evans; the International Monetary Fund, by Edward Bernstein; the World Bank Group, by Roy Blough; the Organization for Economic Cooperation and Development, by Goran Ohlin; the Alliance for Progress machinery, by Raúl Sáez; the several regional development financing agencies, such as the Inter-American Development Bank and the African Development Bank, by Henry Bloch. Much of the material in this first group of essays is descriptive and historical, but there is considerable analysis and critical appraisal. The authors, most of whom have had intimate acquaintance with the institutions they discuss, have in most cases avoided stereotyped presentation in terms of charter provisions, statistical compilation of activities and organizational charts. Nevertheless, readers familiar with the literature on aid institutions and assistance coordinating agencies will learn little that is new. A critical analysis of institutions must be based on case studies in depth which reveal what they do as opposed to a recital of what they say they do. A few of the essays in this group provide an interesting history of the evolution of the agency and its policies. Of special value in this connection is the study by Raúl Sáez, "The Nine Wise Men and the Alliance for Progress."

The group of essays concerned with specific development and external aid problems covers such topics as the role of trade in economic development, by Isaiah Frank; private foreign investment, by Stanley Metzger; education for development, by Robert Cox; world population, by Richard Gardner; food and population, by Roger Revelle; the application of science and technology, by Sherman Katz; a world development plan, by Jan Tinbergen; multilateral technical and financial assistance, by Karl Mathiasen and Frank Coffin; and aid consortia, by P. N. Rosenstein-Rodan. In nearly all cases the problems are discussed in a context of international agency programs for dealing with them. A few of the studies go beyond a review of the familiar literature to a formulation of the author's unique approach to the problem. Particularly noteworthy in this regard is Richard Gardner's specification of a world population program. Robert Cox's essay on education for development raises so many intriguing questions regarding what should and can be done in this field that the reader is left to wonder whether the various external agencies concerned can play a useful role.

In Max Millikan's Preface and in the thoughtful overview chapter by Robert Asher, there is an apologetic awareness of the great proliferation of international, regional and bilateral assistance agencies since World War II, a mere listing of which would fill several pages of print. Perhaps as Asher suggests, the development problem may have been "overinstitutionalized" in the sense that success is believed to depend more on external aid and environment than on internal will and performance. This proliferation of external agencies has been created in response to a recognition of a variety of development prob-

lems regarded as amenable to outside influence, but their number is further enhanced by a recognition of the need to coordinate their activities at the national, regional, and international levels. But as the essays on the OECD and the Alliance for Progress have demonstrated, coordination is thwarted by the national interests of the donor countries and the vested interests of the individual international organizations.

But aside from the inefficient use of administrative manpower, is this profusion of agencies, many of which are engaged in the same kinds of operations, necessarily bad? Those who think in terms of national economic plans which move forward with mathematical precision provided the right amounts of inputs are forthcoming at the proper time, disparage this diffused approach to external assistance. They prefer, as does Rosenstein-Rodan, program loans for injecting the proper amount of capital for fueling the development plans, and reject the haphazard process whereby a number of multilateral and bilateral assistance agencies shop around the developing world for bankable projects which conform to their aid philosophy or national economic and political interests. Jan Tinbergen believes it is time to begin thinking about a world development plan which would be superimposed on some hundred or more well-structured national plans. On the other hand, those who view social and economic progress as a kaleidoscopic phenomenon involving a complex process of socio-political, cultural, and economic change, the behavior and interrelations regarding which we are all too ignorant, are less concerned about the variety of competitive and perhaps experimental activities in development assistance.

The attempts by Millikan and Asher to tie all these efforts together in terms of an assessment of "global partnership" is predictably less than wholly satisfactory. The evaluation of the contribution of international agencies to development must begin with case studies of the particular countries receiving their largess. There is no general theory of development which can be tested empirically, nor is there a general theory of foreign aid.

In conclusion, this is a useful book, especially for those less familiar with international agencies concerned with development. It is well edited, with a view to the integration of the material around central themes and the avoidance of duplication. Some of the essays will be worth reading even for those who have specialized in the subject considered.

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*International Trade Problems of Small Nations.* By PETER J. LLOYD. Durham: Duke University Press, 1968. Pp. vi, 140. \$6.00.

We are being buried by an avalanche of books on economics. There are over thirteen hundred books listed in the 1967 issues of the *American Economic Review* as compared to five hundred twenty years earlier. Nothing comparable has happened with economic periodicals. Although a few specialized journals have been newly published, among general journals we have the old staples, both in the United States and Britain. The explanation is easy to find: there is a strict selection process in journals but not in books. Only about one-tenth of the papers submitted to economic periodicals see the print,



while commercial publishers search the universities for textbooks and for profitable monographs, and small university presses try to justify their existence by maintaining a steady stream of publications.

The books are added to the shelves of libraries, reviewers dutifully indicate their merits and demerits, and the process begins once again. But how many times do we ask if the book should have been written at all? How often do we raise the question whether its publication brings benefits to anybody other than the author, or perhaps "disutility" to the few unsuspecting graduate students who come to read it? I am afraid that these questions are asked only too rarely. It is my purpose to raise them in connection with Mr. Lloyd's study on the "International Trade Problems of Small Nations."

The question of size is an important one. There is a growing understanding of the fact that we cannot recommend the same development strategies to Brazil, Peru or Guatemala; it is widely agreed that among developed nations, the trade interests of the United States, the United Kingdom and Sweden are not the same; the countries of Eastern Europe learned from bitter experience that the autarchical model of Soviet planning is hardly applicable to them. In turn, in teaching international trade theory, we find the abstraction of the "small country," which is a price taker in the world market, useful in introducing graduate students to trade theory.

But can a single criterion be used to denote size, and can we separate nations into two groups, "large" and "small"? Mr. Lloyd suggests an affirmative answer to both questions. In his view "it is essential that the measure of size be single-valued" (p. 11) and "we must choose the critical value of the index of national size which is to separate small from large countries" (p. 12). He suggests the use of gross domestic product for this purpose and selects \$20 billion as "the upper limit for small countries" (p. 31). But is GDP the appropriate measure or should we rather take marketable or nonsubsistence income which is relevant both for international specialization and for scale economies that supposedly determine the choice of the size criterion? Is Australia with a GDP of \$20 billion correctly classified as a small country and India with \$36 billion a large one? And does Australia have more in common with Ireland (\$2.6 billion) or with Canada (\$40 billion)? These questions are not raised by the author, and in selecting the fifteen developed countries which come under the definition he complacently declares that all the countries included in the group "certainly fit the usual ideas of smallness" (p. 33).

The scope of the investigation is restricted to small developed countries largely to avoid "the possible confusion of the effects of smallness with the effects of low per capita incomes" (p. 30). In the comparisons of theory and reality, however, Lloyd considers a mixed group of developed and developing countries, and in no case compares data for small developed and large developed nations. The results are then used to "disprove" what he considers to be the received theory of small countries.

In the concluding section of the book Lloyd asserts that "small countries do not generally have the trade characteristics which the builders of the models believed them to have. If a small country is defined as any country whose GDP was less than \$20 billion in 1964, it is quite clear that the trade ratios

[the sum of exports and imports as a proportion of GDP] and degrees of export concentration of these countries vary widely around the all-country averages" (p. 124). But these results are derived by combining data for developed and developing nations, and the conclusions change if we restrict the investigation to developed nations. We find, then, that all the 14 developed nations with a GDP less than \$20 billion have a higher trade ratio than any of the eight countries with a GDP of over \$20 billion (Australia belongs to the second rather than the first group) and the rank correlation coefficient between the two variables is 0.72. The coefficient will be larger if we exclude from the sample the exporters of primary products (Australia, Finland, Ireland and New Zealand), the trade characteristics of which obviously differ from those of industrial nations.

Lloyd further claims that there are many exceptions to the assumed relationship between a high trade ratio and a high degree of commodity concentration of exports and "this finding alone destroys part of the foundation of the general theory of small nation trading" (p. 30). But here again the results change if we confine the investigation to developed nations, as they conceivably will change with respect to export instability where Lloyd compares the data for his group of small developed countries with an average for both developed and developing nations.

More generally, one may question Lloyd's procedure of criticizing the theoretical models of small nations by the use of empirical data pertaining to a heterogeneous group of countries. He seems to forget the fact that the models represent abstractions based on *ceteris paribus* assumptions. Should these assumptions be made, the conclusions follow and they are useful in understanding international trade theory, notwithstanding the empirical results pertaining to a given group of countries with widely differing characteristics.

The chapter on the effects of the devaluation is a case in point. Lloyd submits that "some small countries—especially the primary product exporters, Finland, Sweden, Australia and New Zealand—are the largest suppliers of their main export products in world markets . . . These statistics refute conclusively the very common contention that the foreign elasticity of demand for the exports of a small country is necessarily high enough to insure that a small devaluation by a small country will be effective in improving the balance of payments" (p. 78). Needless to say, the theoretical propositions apply to countries with similar export patterns and they do not purport to equate the situation of primary exporters and countries exporting manufactured goods.

A separate chapter deals with the foreign trade multiplier. This time, Lloyd accepts the assumptions customarily made for small countries and reaches the conclusion that these countries will tend to have small multipliers and small foreign repercussions. This result is unobjectionable but it does not require the tedious derivations provided in the text and the appendix, since the relevant formulas are well known. Another chapter presents Graham's multicountry, multicommodity model as one which produces "some valuable suggestions concerning the international trade of small nations" (p. 125). It would appear, however, that the product homogeneity and constant cost assumptions

underlying Graham's model have little applicability to the case of industrial nations which export chiefly differentiated products and derive much of the gains of international specialization from scale economies and competition. Neither scale economies nor the effects of competition are adequately discussed by Lloyd, who moves directly from the short-term effects on the reallocation of existing capacity to agglomeration economies. The evidence he provides is not sufficient, therefore, to reach the conclusion that the connection between the size of nations on the one hand, and economies of scale and the degree of competition on the other, is "tenuous" (p. 125).

Lloyd has painstakingly searched the literature for bits and pieces on the problems of small countries, but has not succeeded in welding these together in a meaningful way. The result is a rather pedestrian exercise which lacks focus and neglects the important question of what implications size has for the gains from trade and for trade policy in countries at different levels of development. We would not be poorer if the book had not been written.

BELA BALASSA

*The Johns Hopkins University and the World Bank*

*Fundamentals of International Economics.* By IMANUEL WEXLER. New York: Random House, 1968. Pp. xiv, 428. \$7.95.

This is an undergraduate text in international trade, aimed at students with an elementary competence in economics. It eschews mathematical treatment, with the one exception of the multiplier, and it is sparing in the use of diagrams.

The principal divisions of the book are: (a) the basis for and gains from trade; (b) external disequilibrium and measures to remove it; (c) trade interference, both public and private; (d) a historic survey of commercial policy in Europe and the United States, with an added chapter on developing countries; (e) regional economic arrangements of the customs-union type.

The discussion of comparative advantage and reciprocal demand is on the whole accurate and readable, starting with Smith and stopping with Marshall. It fails, however, to take into account Graham's contribution. And so, under the assumption of constant opportunity cost, the reciprocal demand curve (p. 82) is curved over its entire stretch. This of course ignores the possibility of incomplete specialization under constant opportunity cost, in which case the reciprocal demand curve must have a straight-line portion. Graham's treatment of constant cost not only for the two-by-two case but also for several goods and several countries is neglected entirely.

Most teachers would welcome the author's stress on opportunity cost but may regret, as the reviewer did, that he fails to make the link between opportunity cost and factor endowments. (The latter he stresses as the principal basis for trade in Ch. 5.) The difference in factor intensities between goods is of course one possible explanation for increasing opportunity cost, since relative factor prices change along with composition of output. The author contents himself with assuming increasing cost, but leaving the reader uninformed about the reasons (pp. 66-69).

Factor-price determination, so important a topic in the modern literature,

and the natural counterpart of output determination, gets only two pages (pp. 73-74) of very cursory attention. A teacher wishing to treat this topic would find it necessary to carry most of the expository burden himself.

The section on external disequilibrium is on the whole well written. After a discussion of the causes, both short-term and long-term, we get a discussion of the specie-flow mechanism, followed by an analysis of the multiplier-adjustment process. The multiplier is dealt with algebraically without accounting for foreign repercussions, and then verbally with account taken of income adjustments abroad. Unfortunately, the reader is left with the impression that the gold-flow mechanism works mainly through the price level, while the multiplier works through the direct impact of export changes. This is of course incorrect, since a change in foreign-exchange position, if permitted to affect domestic monetary conditions, also leads to a multiplier process, started via domestic investment and possibly consumption.

The alternative to fixed exchange rates, in the form of rate adjustment, along with its difficulties, is effectively stated in a few pages. The author keeps himself uncommitted as to whether the fixed-rate-domestic-adjustment route, or the variable-rate one is to be preferred. The third alternative, direct interferences with trade and payments receives discussion as a temporary expedient which does not solve the underlying causes of disequilibrium. The section ends with a discussion of proposals and measures to increase international liquidity, including a brief history of postwar measures and discussion of the Triffin Plan and other proposals.

As in other standard texts, the discussion of government commercial policy fails to use the reciprocal demand curves developed in the early part. It follows rather closely the development of Kindleberger, with his distinction among revenue, terms-of-trade, redistribution, and protective effects. While the use of ordinary demand and supply curves does not require one to think in particular-equilibrium terms, it does encourage this tendency. And so the author fails to point out the rather important fact that export and import duties have similar economic effects. This is one of the findings of A. P. Lerner's famous article, "The Symmetry between Import and Export Duties."<sup>1</sup>

The final part of the book deals with regional economics arrangements and competently treats the customs union issue. It gives space to the principal regional groupings, including both the European and Latin American ones. It would have been appropriate to give some space also to the East European regional organization.

On the whole this is a readable book. It is informative on current and past policies; where it is somewhat lacking (perhaps in part by choice) is in economic analysis. It is the sort of text which can be read with relatively little difficulty by the student with only a training in beginning economics, or by the intelligent lay reader. It is apt to place too small a demand on an undergraduate senior.

FRANZ GEHRELS

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<sup>1</sup> A. P. Lerner, *Essays in Economic Analysis*, London 1953.

### **Business Finance; Investment and Security Markets; Insurance**

*The Theory of Business Finance: A Book of Readings.* Edited by STEPHEN A. ARCHER and CHARLES A. D'AMBROSIO. New York: The Macmillan Company, 1967. Pp. xiv, 713. \$9.95.

Every now and then, a definitive book appears. This is such a book, and it fills a long felt need for an up-to-date coverage of the dynamic and sometimes controversial field of business finance.

The editors have collected 43 important papers from 15 different scholarly journals to provide this very useful readings book for financial professionals and serious students of capital theory and enterprise finance. As an academic textbook it is most appropriate for courses in corporate finance or managerial economics.

The book is organized into four main parts: "The Conceptual Background, which covers the goals of business finance and the problem of choice under uncertainty; "The Supply of Capital," which covers the cost of capital, capital structure mix, and dividend policy; "The Firm's Demand for and Allocation of Capital," which is concerned with capital budgeting; and "Capital Markets," which covers portfolio selection and stock evaluation problems. These main parts, except Part Four, are, in turn, further subdivided into smaller groups of articles on more specific, narrower topics.

Part One includes four articles by Bodenhorn, Bernoulli, Friedman and Savage, and Hirshleifer which set the stage for the rest of the book by introducing the fundamentals of profitability, risk and uncertainty, and choice theory which are relevant to the operations of profit-seeking enterprises.

Part Two is subdivided into three sections. The first section presents a complete treatment of the most controversial aspect of business finance: the cost of capital, by including not only the Modigliani and Miller paper which started it all but also, the comments by Durand, Weston, Boness, and Brewer and Michaelson along with the replies by Modigliani and Miller. This comprehensive coverage presents, in one convenient package, enough of the flavor of the controversy while also bringing the reader up to date on its present status. The second section contains four articles, by Schwartz, Gordon, Solomon, and Lintner on the question of the optimal capital structure of the firms. Section three also contains four articles, by Walter, Lintner, Miller and Modigliani, and Gordon, dealing with dividend policy and the valuation of the firm.

Part Three concerns capital budgeting; its two subdivisions include eight articles each. The first subdivision includes articles by McLean, Hertz, Hirshleifer, Smith, Hillier and Bodenhorn dealing with the problem of measuring the merits of specific capital proposals in an uncertain world. The second group of articles by Bennion; Charnes, Cooper, and Miller; Baumol and Quandt; Paine, Cord, Dyckman, Baumol, and Archer deal with the methods of internal capital allocation such as: game theory, mathematical programming, and inventory theory. This second section builds upon the base established by the first section to push out to the frontier areas of this important topic. These papers are important for their contributions to the decision

making process of the firm as well as for their implications for national anti-cyclical economic policy making.

Part Four contains six articles by Markowitz, Tobin, Hirschleifer, Lerner and Carleton, Sharpe, and Lintner dealing with various aspects of capital theory of interest both to business managers and investors who are concerned about how the market values business firms.

Overall this is an excellent readings book which should be especially useful in graduate courses in corporate finance, investments, and managerial economics, as well as to practitioners interested in these topics. The editors should be congratulated for an excellent performance of the extremely difficult task of selecting only the most relevant papers from among all the excellent ones produced by both scholars and practitioners.

ALFRED L. KAHL, JR.

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### **Business Organization; Managerial Economics; Marketing; Accounting**

*Executive Compensation in Large Industrial Corporations.* By WILBUR G. LEWELLEN. New York: Columbia University Press, for the National Bureau of Economic Research, 1968. Pp. xxv, 371. \$13.50.

Since the introduction of high personal income tax rates (on a progressive basis) during the early years of the nineteen 'forties by the federal government, it has never been exactly clear just how well top executives in American corporations have made out on an after-tax basis, both absolutely and relatively to other earners in the economy. Other forms of compensation, it has been well known, have been introduced to supplement salary and bonus with increasing frequency to ease the bite of the income tax: pension plans, deferred compensation, profit sharing programs, and stock options. In one of a series of studies undertaken by the National Bureau of Economic Research to add to our knowledge of the influence of tax policies on economic growth, Professor Lewellen has taken published reports of top executive compensation in 50 large manufacturing companies, has made supplemental compensation forms comparable so far as possible with salary payments, and has laid out the history of compensation from 1940 through 1963. He has done this with diligent effort, great patience, and considerable skill. The result is a definitive study of what has happened to executive compensation in large corporations in the past quarter century.

The book, very readable, is merciful to the reader. Part I, occupying roughly one-third of the total, defines the various forms of executive compensation and explains how nonsalary forms are made comparable to cash payments. Probabilities of death and living and discount rates are relevant in these comparisons, but a rigorous treatment of them is placed in appendices. To understand the argument, it is not necessary to pore over the appendices. Indeed, the general reader is invited to skip entirely the introductory chapters and to proceed directly to the empirical findings, which take up the latter part

of the book. These findings rest on data covering the experience of about 550 executives covering some 8,000 man years' worth of compensation history.

An initial finding is that salary and bonus income of the top five executives for all 50 companies has increased by 83 per cent before taxes and 33 per cent after taxes since 1940. However, their total remuneration after taxes has approximately doubled. Deferred and contingent rewards, which now account for about half the pay package, have accounted for the major portion of the increase in aggregate remuneration. Restricted stock options, originated by tax legislation in the early 1950s, have provided nearly one-third of all after-tax compensation enjoyed by senior executives in recent years. Largely as a result of this development, the year-to-year volatility of executives' pay has increased substantially, and their earnings have become closely linked with the performance of their company's stock. Most of the growth in pay occurred in the ten years immediately following World War II.

Growth in executive pay has not been very impressive in relation to relevant historical indices. In total, sales, assets, profits, and market value of the corporations for which the executives worked grew much more rapidly than the total compensation of those executives. Physicians, lawyers, and dentists have also done better over time: their 1963 after-tax incomes ranged from 2.4 to 3.2 times 1940 earnings as compared with 2.1 for top executives. Manufacturing production workers earned 3.6 times as much after taxes in 1963 as in 1940, and the take-home pay of recent MBA graduates increased four times. After adjusting for price changes, the senior executives in the sample were no better off in *real terms* in 1963 than in 1940.

Looking at the cross section data for the top five executive positions, the percentage compensation differentials are almost the same now as in the early 1940s. Relative to the aggregate compensation after taxes for the highest paid executive, the rewards for the other four positions surveyed were 67, 56, 45 and 38 per cent for the period 1955-63 as compared with 64, 53, 45 and 40 per cent in 1940-41. Since salary and bonus differentials between the top paid and four closest subordinates have narrowed considerably over the period, Lewellen concludes that corporations have planned their compensation packages to maintain the after-tax structure of senior executive rewards in response to sharply rising personal income tax rates. This was accomplished by using deferred and contingent compensation patterns more heavily at the top positions. Between 1955 and 1963, 62, 50, 44, 36, and 31 per cent of all after-tax compensation attached to the five highest paid positions, in descending order, was accounted for by means other than direct cash payments.

These are only a few of the many interesting findings presented in this volume. The conclusions depend in a crucial way on the transformation of very different compensation arrangements into current dollar equivalents. This transformation, which is somewhat similar for each of the deferred and contingent compensation arrangements, may perhaps most easily be described in terms of pension benefits, which are familiar to most readers. Suppose a corporation introduces a plan to pay noncontributory retirement benefits to a class of employees, including executives. Lewellen values that pension to an executive as the annual premiums required to purchase from an insurance company

a retirement annuity equal in value and comparable in form to the pension promise. This is the "after-tax current equivalent" of the pension. By taking account of personal income taxes that would be paid on salary increments, a "before-tax current equivalent" may also be computed. In the case of a stock option, the after-tax current equivalent is that salary increase (spread over the same term of years as the option) whose present value is equal to the excess of market price of stock over option price. The current equivalent is re-computed each year, and a final reckoning made when the option is exercised.

Applied to pensions, deferred compensation, and stock options, the current equivalent technique may give rise to extraordinary increases in an executive's annual income, especially in the later years of life. The author's rationale is to compute a current equivalent which the executive would be as willing to accept as the original compensation instrument. In spite of this assumed indifference, it seems rather arbitrary to count the cost of past service pension benefits, granted for a lifetime of company service, as additional income in the last few years of an employee's life. And it seems arbitrary to count as "income" unrealized appreciation in a company's stock which is not yet owned by the executive. Nevertheless, there is no accepted technique for handling such cases, and Lewellen has at least constructed a logical and plausible device for dealing with such situations. His book is a significant contribution to the literature on executive compensation, and it will be a standard reference work in the field.

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*Enterprise and Environment.* By NEIL W. CHAMBERLAIN. New York: McGraw-Hill, 1968. Pp. xi, 223. \$7.95.

Neil Chamberlain's reflections on the decision process, mainly in large enterprises, form the basis for this interesting and, at times, provocative book. The book is divided into two parts. The first deals with the administrative structure of firms and its impact on the decision process; the second is concerned with the impact of the firm's environment on decision making. Since the first part of the book is the more successful of the two, I shall focus most of my discussion on it.

The author conceives of the firm as a "complex of interpersonal relationships" organized for a common goal defined by the "corporate personality." The managers of a firm are not a homogeneous group but are rather individuals with differing and, at times, conflicting objectives. Objectives are, in turn, determined partly by the personality of the manager and partly by his position within the corporation. Since hierarchical control is only partially effective, all administrative and strategic decisions result from a complex bargaining process within the firm.

What distinguishes the firm from other types of organization is its pursuit of profit as a primary goal. Chamberlain, however, rejects both profit maximizing and satisficing as managerial objectives because he believes the margin of uncertainty associated with alternative strategies is too large to make close calculations meaningful. Rather, he argues, firms select strategies that are ex-



pected to yield acceptable profits and concurrently pursue the goals of expanding sales revenue or the asset base. In this respect, his position appears to be close to that of Robin Marris. He also concurs with Edith Penrose that growth is pursued to utilize more intensively managerial time which is continually being released as strategic decisions become routine. Profits or growth, however, are only general goals which are achieved through the choice of some set of strategies, and it is these strategy sets that are the subject of internal bargaining and that define the corporate personality.

The above outline is only the skeleton to which Chamberlain attaches many interesting reflections and insights. What is lacking, however, as in most organization theory, is a set of hypotheses presented with sufficient rigor to permit empirical tests. Moreover, the absence of an explicit model leaves unanswered a number of crucial questions. For example, how does a strategy set become sufficiently stable to define a corporate personality. The personalities and aspirations of managers vary, hierarchical control is of limited effectiveness, and the tenure in office of most chief corporate executives is fairly short. Why, then, are not strategy choices merely the consequences of momentary equilibria of conflicting forces, with little continuity? How frequent are realignments among managers in the bargaining process and what variables affect the stability of alignments and of policies?

An even more basic issue is the question of how important strategy choices are as compared to constraints arising from competition, from the character of the market, and from the intrinsic limitations of perceived opportunities. While the imagination of managers doubtless affects what opportunities are discovered, it may well be that alternative strategies play only a minor role in that most managers react in the same way when faced with the inherent constraints of a situation. Perhaps it is this that permits firms to function as integral units even when their division managers have conflicting aspirations. Moreover, if strategies are really important, why do not the superior results of superior strategies become apparent and imitation lead to homogeneity? Or are there insurmountable obstacles to imitation? To resolve the issues Chamberlain raises, one needs to specify a model in sufficient detail so that predictions based on alternative hypotheses can be distinguished and tested empirically.

These comments are less a criticism of Chamberlain than of the present state of organization theory. The author has made a valuable contribution to our understanding of the decision-making process by offering numerous insights which, hopefully, will eventually find their way into more formal statements of hypotheses. This is sufficient contribution. Chamberlain, incidentally, is pessimistic on the usefulness of economic theory in explaining strategy choices. He believes that theory helps explain what he calls "routine" decisions, but the usefulness of generalizations about policy choices is severely limited by diversity in behavior. Variant behavior, he argues, introduces indeterminacy. "The central tendencies of corporate behavior generate some predictability, but the dispersion of behavior following from variant strategy sets opens up the possibility of thrusts and probes which are unpredictable but potentially influential on the economy." Once again, this raises empirical ques-

tions. How pronounced are the "central tendencies" and how stable is the economic behavior of corporate managers?

The second part of the book examines the effect of environment on decision making and has the ambitious objective of describing the relation between the firm and society. It is not surprising that the objective proves elusive. Nevertheless, the author has interesting comments to make on a broad range of subjects including the character of planning, the relation between the values of society and the objectives of firms, the use of firms by governments as instruments of foreign policy, and the conflicts between the sovereignty of international firms and of the governments of the countries in which they operate.

All in all, the book offers rewarding reading to those interested in managerial problems and in organization theory.

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### **Industrial Organization; Government and Business; Industry Studies**

*Monopoly, Big Business, and Welfare in the Postwar United States.* By DEAN A. WORCESTER, JR. Seattle: University of Washington Press, 1967. Pp. xii, 243. \$12.50.

The title of this book is not so much misleading as incomplete. It is about monopoly, big business, and welfare and many other things as well. The wide range of subjects treated makes a tolerably accurate summary of results impossible in a short space and the composition of a review downright hard work. I would begin by guessing that, with severe editing, at least three-fourths of the material presented could be disaggregated into three self-contained parts: a study of the role of product differences in microeconomic theory, a critique of the recent professional literature on industrial organization (broadly defined), and a presentation of the case for analyzing the American economy on the hypothesis that firms act independently, i.e., without collusion, to maximize short-run profit. Specialists in industrial organization will probably find this last part the most rewarding while the other parts are likely to have the greater interest for nonspecialists.

Worcester argues that since every industry began as a single firm, it should be possible to infer something about business motivation from the distribution of firm size and market shares as revealed in the statistics on mature industries. (Legally, free entry is assumed.) By my reading, Worcester seems to view the behavior of a pioneer firm as going through three stages. In the first, it has the industry to itself and charges what it believes to be a profit-maximizing price. As new firms enter, the pioneer firm clings to its original output and lets price fall. Finally, when entry by rival producers has eliminated all except normal profits, while demand continues to grow, it seeks to preserve its market share.

Worcester acknowledges that such a holding operation is not, strictly speaking, a maximizing strategy. But he argues convincingly that, for the firm with

(approximately) constant unit cost over the economically relevant range of its output and limited information about present and future demand, this operation closely approximates such a strategy. The intriguing feature of this approach is that it generates a distribution of firms ranked by size which is (approximately) log normal. That is, the oldest and largest firm is twice the size of the second oldest and second largest. This second firm is twice the size of the third oldest and third largest, etc., (p. 84). For readers who are instinctively suspicious of the above hypothesis, Worcester brings forward two alternative explanations of firm behavior—collusion (especially as manifested in price leadership) and limit or stay-out pricing where the firm sacrifices most of its short-run profit to discourage new firms from entering. If a collusive strategy is followed, firms will be of more nearly equal size. If stay-out pricing is chosen, the oldest firm will be much larger than any other.

Having related expected industry structure to these three hypotheses, Worcester examines the relevant data for the American economy and finds that they are, for the most part, consistent with the hypothesis that most firms use an independent maximizing strategy. This result seems to have been anticipated by the author. Early in the book he argues that stay-out pricing requires too much information to be preferred strategy while the possibility of cheating undermines the economic appeal of collusion.

My own feeling is that, as an industry matures, the firms come into possession of information which, when pooled, makes stay-out pricing an increasingly attractive alternative; that, while any form of tacit collusion or legally unenforceable contract is vulnerable to chiseling, a corporate merger definitely is not, and hence that, in the absence of antitrust laws, the normal condition of a mature industry is the dominant firm pattern which was emerging in American manufacturing industries before the Supreme Court broke up the oil and tobacco trusts in 1911. In an earlier article Worcester attributed the decline of the dominant firm in the United States to the burdens of price leadership; he felt that, while the dominant firms as the price leader had to play the game to make it work, smaller rivals were able to discretely, remorselessly, and successfully cheat. Personally, I find the deliberate use of the antitrust laws to substitute oligopoly for "monopoly" to afford a more plausible explanation of the dominant firm's decline. I must remain respectfully skeptical of Worcester's fundamental premise that entrepreneurial goals can be inferred from concentration statistics.

The universe being biased in favor of theorists, short reviews are inevitably unjust to important books with substantial empirical content. Therefore, I would conclude with the estimate that this book ought to be read by all specialists in industrial organization for its fresh thinking on old and difficult issues—and as an introduction of some new and difficult ones. Notwithstanding some serious faults of organization and a tendency to take a great deal for granted in the reader, it can usefully be studied by anyone who wishes to check on recent developments in an important, little publicized, and rapidly changing area of economics.

DONALD DEWEY

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*Investments for Capacity Expansion: Size, Location, and Time Phasing.* Edited by ALAN S. MANNE. Cambridge, Mass.: The M.I.T. Press, 1967. Pp. xv, 239. \$10.00.

The present volume is an outstanding contribution to the application of the techniques of process analysis to industrial development planning. Process analysis, as defined by Manne earlier (with Markowitz, [2, p. 3]) "... treats industrial capabilities in terms such as blast furnace capacity, petroleum product specifications, and metal machining operations—in contrast with approaches which treat capabilities in terms such as gross national product or interindustry sales and purchases."

The volume is built around four case studies presented in Part I (about two-thirds of the text), concerning aluminum, caustic soda, cement, and nitrogenous fertilizer industries in India. All of these are by Manne, the last co-authored by P. N. Radhakrishnan and T.V.S. Rama Mohan Rao. For each of these industries, a locational analysis was required for determining the number of producing points and the tributary market areas of each. "The viewpoint here is that of a preliminary investment survey, one that provides a rough framework within which to draw up a detailed proposal for the *next* project to be built. The conclusions of such a preinvestment survey are intended to serve as the initial premises for a specific project: when, where, and how large a unit to construct" (p. 20).

What is novel in these case studies as contrasted with previous locational analyses underlying industrial development programs is the explicit consideration given to the time phasing of investments. The introduction of a dynamic framework is far from academic: the results of the locational studies hinge critically on the precise interlock between differently phased investments at different locations, with a seesaw pattern of commodity transport linking different producing points, in line with their temporary capacity surpluses or deficits.

The theoretical difficulty of such an analysis consists in optimizations involving nonconvex point sets. Since many local optima are available, local optimality conditions offer no guarantee of achieving a global optimum. Nonconvexities enter by way of economies of scale in regard to fixed investments. In dynamic problems involving multiple locations, diseconomies of small scale must be balanced against both transport costs and the discounted costs of idle capacity as new plants are built to keep ahead of expanding demand.

While a numerical example of time-phased investments at two productive locations, with back-and-forth transport between alternating capacity surplus and deficit points, had been published earlier [3], the present volume not only provides the first operational application of the idea of time phasing, but also makes a series of pioneering contributions (in Parts II-III, the last third of the volume) to the mathematical theory and computational problems concerning such systems. Chapters by T. N. Srinivasan and Donald Erlenkotter generalize and deepen Manne's earlier results on dynamic single-location systems [1]; Manne and A. F. Veinott, Jr., prove a fundamental theorem for optimal capacity schedules with arbitrary increasing time paths of demand; Erlenkotter formulates a dynamic programming solution to the system that is ingeniously re-

duced in size by utilizing the structural features of optimal investment schedules; and finally Manne defines, tests, and applies to the Indian case studies an imaginative heuristic algorithm that is based on restricting the investment schedule at each location to constant time intervals while simultaneously tying them together into a major cycle that repeats indefinitely.

Manne is at his best when devising sophisticated algorithms and operations-research techniques which he brings to bear on practical problems. The four case studies included in the volume are classical examples of preinvestment analyses that are both inspired by the best available technique and fully down to earth. He also has the gifts of a natural teacher: the case studies and background discussion of Part I are presented with a lucidity and an intuitive grasp that make them eminently suitable as assigned readings for courses of industrial economics or economic development, and even for intermediate economic theory courses. The heady atmosphere of reality pervading these case studies, with their powerful nonconvexities, nonmarket features, and technical-institutional detail, makes them an effective antidote against the stultifying scholasticism of many of the standard theory texts.

The major empirical result that emerges from the industry studies is that the calculated optimal plant sizes tend to be considerably above the actual plant size proposals of the Fourth Plan of India. Manne's interpretation of this discrepancy and his resulting policy conclusions are, however, subject to some reservations. Manne attributes the discrepancy to "... a political bargaining process with piecemeal decision making," and to "... the absence of conscious and deliberate benefit-cost calculations." In so doing he takes it for granted that the optima that emerge from his models are at least in an approximate sense also socially optimal, a point subject to some doubt. In discussing qualitative factors that might bias his results upward or downward with regard to plant scale—and which he dismisses as mutually offsetting—he omits one which in fact may be critical, namely the stimulating effect of more dispersed development on the formation of savings, skills, and technological progress in *otherwise stagnant areas*. The key question is: does an increase in plant size deprive some areas of needed economic development? As Manne emphasizes, this cannot be answered when looking at a single industry in isolation, since an area passed over by one industry may well attract other industries. Still, a general policy conclusion to increase plant sizes must be thoroughly checked against the possible setback to the development of smaller centers that may be implied, especially when computed cost differentials on which such a recommendation is based are narrow. The "political bargaining process" may well reflect the external benefits of dispersed development; more "sophisticated" benefit-cost analyses could then result in pushing the system *away* from socially desirable positions! Incidentally, Manne's time-phased locational models are doing far better in this regard than his benchmark models postulating isolated productive locations, since the time-phased models greatly reduce the apparent disadvantage of dispersed development—a result implicit in Manne's tabulations for the two chemical case studies.

The investment schedules that emerge from the case studies raise interesting questions concerning the *joint* planning of equipment-using and equipment-

supplying industries. Manne broaches one of these questions—plant size standardization—in a single specific case. The general problem appears to be the logical next candidate for an extension of the methods of this volume. This may provide the key to some hitherto puzzling phenomena, such as the non-Keynesian capital investment cycles observed in centrally planned economies, or similar swings in the orders of equipment suppliers to national power authorities.

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*The Canadian Economy and Disarmament.* By GIDEON ROSENBLUTH. New York: St. Martin's Press, 1967. Pp. x, 189. \$5.50.

Most economists have a good—but very imprecise—idea of the major turn-around in the economy required by disarmament; in this thorough and useful study, Rosenbluth fills in the details for the Canadian case.

Recently, about 4-5 per cent of Canadian G.N.P. has been generated by defense spending by Canada and by other countries (especially the United States). Rosenbluth traces down the direct and indirect industry implications on Canada in a three-level input-output analysis.

First—and most important by far—is Canadian government expenditure on domestic military purchases; the sectors most dependent on this are transportation equipment (especially aircraft) and electrical equipment. Second is the U.S. government's direct military purchases in Canada. Finally, U.S. defense expenditure in the United States generates secondary and tertiary purchases in Canada, with the Canadian sector most dependent on U.S. defense spending being metal mining. So far there are no great surprises, except perhaps that U.S. government expenditures have only about one-third the impact on Canada of Canadian government expenditures.

But the more important issue is: "With disarmament how are these expenditures to be replaced?" Rosenbluth goes through the catalogue: education, hospitals, poverty programs, and the like; alternatively, the ultimate guarantee of adequate final demand—a tax decrease. Closing this expenditure gap raises problems that are essentially political, rather than economic.

The key economic problem is the one of resource mobility as total demand is reallocated in an entirely new pattern. Here Rosenbluth identifies the specific firms, areas and occupations for which outward mobility might be criti-

cal. But the evidence is that there is already high mobility of the Canadian labor force even in normal conditions when there are no great pressures for resource reallocation: . . . "nearly half the labor force changed jobs within a year (data for 1956-60). More than one-third changed their occupations, more than one-fifth their industry . . ." (p. 103). The conclusion of this study is that adjustment to changing demand patterns would involve no insurmountable problems, especially in view of various adjustment assistance programs that could be brought into play.

Thus, the major contribution of this book is to show that, although defense expenditure may be a vested interest of the contractors and subcontractors involved, it is not a vested interest of the public at large. But paradoxically in making this case so well, Rosenbluth weakens his call for more elaborate governmental machinery for further study of economic implications. This reviewer is left with the feeling that the things that should be said for Canada have now been pretty well covered by Rosenbluth. The domestic problems may be handled relatively easily once the more intractable international political problem of disarmament is solved. Is not this latter issue the one that now deserves the additional resources?

While some of the descriptive material does not make for very exciting reading, the book is clear and concise. For example, the introduction to the chapter on the Effect of Disarmament on Research and Development is a fine primer on the economics of R and D; there is also an interesting discussion of how scale efficiencies have drawn Canada into defense sharing agreements with the United States.

This book should be useful for policy makers as they come to deal with problems of disarmament in the future. But more broadly, it suggests guidelines for other studies of economic dislocation—for example, the effects of tariff reduction or technological change.

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*Investment and the Return to Equity Capital in the South African Gold Mining Industry, 1887-1965.* By S. HERBERT FRANKEL. Cambridge: Harvard University Press, 1967. Pp. x, 131. \$9.95.

One of the main points at issue in this study is whether the internal rate of return<sup>1</sup> to equity capital in 116 large South African gold mining companies tends to equality with those in other industries and countries after allowing for risk and special circumstances. If the firms in the South African gold industry had been buffeted by sizable unexpected changes and forces to a much greater extent than industry in general, we should not expect a strong tendency to equality. Frankel finds what he regards as a close correspondence

<sup>1</sup> In calculating the internal rate of return, the capital input series begins with original capital paid in or the market value of the shares if the period of the calculation begins after the birth of the firm. Shares issued for in kind contributions (e.g., mineral rights) are valued at market. The dividend series always is followed by the market value of the shares as of the end of the period. Direct determination of depletion is not required by this method, this being done implicitly by the market in setting the beginning and ending equity capital values.

between the return to South African gold and U.K. equities. For example, from 1919 to 1963, the gold companies yielded 9 per cent (the average of successive 10-year internal rates of return) as compared with 7.5 per cent for U.K. equities and 2.8 per cent for U.K. consols. From 1935 to 1963, gold mining yielded 4.3 per cent as compared with 7 per cent for U.K. equities.

There are many deviations from uniformity of return that call for explanation, of course. The slightly higher return to Mining Groups and Finance Houses is explained by special risk bearing and administrative functions. The lower rate of return to gold compared with equities after 1935 is thought to be explained mainly by the continued expectation that the persistent fall in the value of gold relative to other commodities would eventually be corrected by a rise in the world price of gold.

Sizable differences in the rate of return between the different gold producing areas of South Africa (for 1887-1965 the rates for the six areas are, in order: 2.2, 4.7, 6.1, 7.5, 9.3, and 9.3 per cent) are said to reflect different costs of exploration, development, and production. If such differences are foreseen correctly, however, there should be no resulting differences in internal rates of return calculated by the procedure used in this study. The observed differences would seem to reflect, instead, the noncancelling errors made by investors in assessing the prospects of mines in the different areas.

In a similar way, variation among the returns of different companies must reflect the differential effects of factors not foreseen clearly. This variation is sizable. For 65 companies in operation for part or all of the period 1887-1932, the interquartile range of internal rates of return ( $Q_3-Q_1$ , including 50 per cent of the firms) was 21 percentage points. For 51 companies established after 1932, the interquartile range for 1933-1965 was 15 percentage points, lower, but seemingly quite high.

Because the study is very spare—only 30 pages of folio size text excluding notes and appendices—it does not exploit fully the variety of calculations and range of comparisons it contains. The wealth of data and completed calculations should be very useful in further investigations of the behavior of this industry, either internally or in relation to other industries. The variation of return among firms and their wanderings in the distribution of returns is a particularly attractive area for further study.

ORRIS C. HERFINDAHL

*Resources for the Future, Inc.*  
Washington, D. C.

*Antitrust Economics: Selected Legal Cases and Economic Models.* By EUGENE M. SINGER. Englewood Cliffs, N.J.: Prentice-Hall, 1968. Pp. xii, 276. \$7.95.

As is frequently true, the subtitle to this book qualifies the main title in an essential way: Eugene Singer supplies a selected rather than comprehensive survey of the antitrust economics area. By way of organization, Singer indicates in the preface that "the legal and economic analyses have been arranged . . . in separate chapters"—which might be taken as a warning to the reader that an integrated analysis is not attempted. Such an interpretation would, in this instance, be correct.



Such a fault (if one regards this as a demerit of the book, as I am inclined to) is not entirely Singer's. The literature on antitrust economics has typically been content with relatively loose connections between the relevant economic theory and its application to specific cases. One might have hoped, however, that Singer's extensive experience as a consultant would have suggested ways of tightening up the connections.

The book is organized in eight sections. Section A deals with the "foundations of antitrust," and includes a weak chapter on welfare economics. Section B is concerned with monopoly. The first four chapters trace the development of "monopoly" interpretations by the courts from Standard Oil (1911) through U.S. Steel (1920) and Alcoa (1945), up to the Cellophane case (1956), with a note on Grinnell (1966). This 34-page survey may well prove a useful reference in undergraduate industrial organization courses. It is followed by a chapter on monopoly indexes.

Section C deals with oligopoly. Both of the chapters on duopoly and oligopoly models as well as the chapter on monopoly indexes tend to be encyclopedic rather than critical. As a result, models are sometimes undermotivated—profit indifference curves, for example, although extensively employed are merely presented rather than derived—and are nowhere critically evaluated. The references are similarly profuse; many appear to lack relevance to this book (for example, those to the recent literature in the *Review of Economic Studies* on the stability of Cournot models).

A chapter on parallel business behavior follows. No attempt is made to develop the relationships between the series of cases that are examined here and the preceding models, although the juxtaposition of these chapters presumably suggests that connections exist.

Section D has three chapters on the concept and measurement of concentration. Much of this is based on research of Singer's published elsewhere, and is among the best material in the book.

The last four sections deal respectively with tying arrangements, vertical integration, price discrimination, and mergers. The policy issues as well as the cases examined in each of these chapters are all interesting. Differences in interpretation from Singer—for example, overconglomerate organization as a system of subsidization—are, however, apt to be common. A chapter which develops conclusions is conspicuously missing.

Singer realistically characterizes the book as a "supplemental text," and indicates that the intended audience is primarily "advanced undergraduate and graduate students in a university department of economics." I would judge undergraduate use to be the more appropriate.

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*Economics of Food Retailing.* By DANIEL I. PADBERG. Ithaca: Cornell University Food Distribution Program, 1968. Pp. xi, 292.

In his Foreword, Professor Padberg notes, "This book grows largely out of the massive economic data collection assembled by the National Commission on Food Marketing," on whose staff he served. It is very convenient for econ-

omists interested in the subject to have so much data relating to food marketing made available in this form, accompanied by a highly competent economic exposition. One hopes that there will be further studies similarly exploring other segments of the general field investigated by the National Commission.

This volume examines all aspects of market structure, behavior, and performance in food retailing, and offers much fuller information on these than has hitherto been readily available. The "industry" has an intermediate level of concentration, averaging about 50 per cent for the largest four sellers in U.S. Metropolitan Areas. Concentration in selling is not now growing, though it increased during the 1950s. Other aspects of structure also seem relatively stable: scale economies are not especially significant and are not increasing, vertical integration is not extensive and also not changing much, and entry is still relatively easy. The author judges most aspects of market behavior to be workably competitive. The economic performance of the industry has been good. The only reservation to this conclusion concerns the purchasing side of food marketing: the author discerns a tinge of monopsony in large wholesaling operation, reinforced by entry barriers at this level and by private-label programs of large buyers. On the other hand, these private-label programs undoubtedly help to forestall monopoly at the level of foodstuff manufacture.

These conclusions are neither new nor startling, but it is reassuring to have them brought up to date and backed with the latest available evidence. The reader will not find any new synthesis of organization theory in this volume, nor fresh insights or methodological breakthroughs. It is practically devoid of theoretical models; the norms of competitive behavior and the analytical framework of structure, conduct, performance are implicit but undergo no new development. One feature of the book is rather puzzling: the presence of "review" questions at the end of each chapter, and a "glossary," in which the level of exposition becomes elementary indeed. One wonders what audience the author had in mind. The book is apparently not intended as a textbook. Perhaps it will be read by people in the industry, who might need the glossary, and by students in undergraduate marketing courses, who might find the questions useful for organizing their thoughts. If so, both groups will be exposed to a competent and professional industry investigation. Economists who do not need these study aids will nevertheless find the information in the book useful and timely.

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### **Land Economics; Agricultural Economics; Economic Geography; Housing**

*Agricultural Development and Economic Growth.* Edited by HERMAN J. SOUTHWORTH AND BRUCE F. JOHNSTON. Ithaca: Cornell University Press, 1967. Pp. xv, 608. \$12.00.

This timely volume contains an interpretive chapter by the co-editors and thirteen individually commissioned contributions on a variety of specific di-

mensions of the general subject under discussion. That subject is, of course, agriculture in the developing economy and the overall purpose of the volume is to drive yet another nail into the coffin of neglect of that important sector. To serve their purpose the editors have taken pains to assemble a highly talented group of contributors—and critics—for each of the subject areas selected.

As is inevitable in a volume of this kind, there are difficulties relating to the integrative nature of the effort—and that remains true in spite of an astonishing amount of cross-referencing. What is achieved is a mosaic with most of the stones well formed and carefully placed, but with an overall design which is not always fully apparent.

For one thing, even when viewed as a collection of readings, there does not seem to be agreement on where in the spectrum between surveying the literature and probing its frontiers the individual articles are intended to fall; for another, though we recognize that no one man, or even a small team, can be simultaneously expert in all the areas encompassed by this volume—some agreement on a fresh general framework for looking at the same animal from different directions is absent. In other words, this is an excellent reference work, a must on the bookshelf of anyone interested in development; only relative to some concept of “what might have been” do we lament the failure to be more innovative.

Moving on to the individual contributions, Chapter 2 presents an approach to a theory of agricultural development by John Mellor. This is a very competent interpretive piece which is distinguished by its effort to relate agricultural development to what is going on in the rest of the developing economy. Mellor traces the components of change in the demand for agricultural output under certain exogenous conditions attaching to nonagricultural growth; understandably he does less well with the more difficult supply side and thus his intersectoral terms-of-trade discussion strikes one as somewhat artificial. He makes a useful contribution in tying up individuals' marginal utility of leisure and marginal product schedules with the withdrawal of labor from agriculture even if he neglects the important Nicholls-Tang type of interaction between the sectors. It is, finally, too tempting not to take issue with his statement that the crux of the difference between the Fei-Ranis and the Jorgenson models has to do with assumptions of zero vs. positive marginal productivity of agricultural workers; what is central is the assumption of classical vs. neoclassical wage determination in agriculture, not the existence or nonexistence of the razor's edge case of zero marginal product.

Chapters 3, 4, and 5 by John Brewster, Cliff Wharton, Jr., and John Montgomery, respectively, take up the issue of the required social and economic infrastructure for successful agricultural development. Brewster is concerned mainly with the need for “stable, progressive government” if increasingly productive technologies are to be absorbed; recent experience in such countries as South Korea, Taiwan, and Pakistan seems to bear him out. It is a little more difficult, however, to accept the implied basic point that this paragon is only to be found at the center, i.e., that “only very primitive technology can be generated and put to use by such small units of collective action as

the extended family, clan, tribe, or village" (p. 94). People can certainly organize themselves creatively in a number of ways for the successful adoption, adaptation, and diffusion of new technology; but it would be difficult to make the case that local bodies, whether farmers' associations, cooperatives, or villages don't have a very important role to play in making an agricultural revolution come off. Perhaps decentralization is, after all, part of what Brewster means by "progressive." In fact, I suspect that Wharton's emphasis on capital-extensive vs. capital-intensive infrastructure, differentiated as to purpose as much as to factor proportions, is really a way of emphasizing the organization-intensive nature of successful agricultural development.

Both Wharton's contribution on economic infrastructure generally and Montgomery's on the role of education specifically may be characterized as comprehensive, competent, and extremely useful annotated bibliographies. They whet the appetite for more, e.g., for light on such perennial questions as the relation of literacy to agricultural development, complementarities among various infrastructural inputs—or perhaps even on an approach to a synthesis of all the listed relevant "factors." But these are not easy questions and perhaps we have no right at this stage of our knowledge to ask for more than a competent survey of the terrain, coupled with the specialist's occasional insight and his prescription for further research.

W. W. MacPherson and Johnston follow up with a fascinating chapter devoted to a description of the distinctive features of tropical agriculture. The fascination derives, in part, from being introduced to an agriculture which until recently has not received the attention it deserves, but also because the relevant features of the terrain are presented in a highly cogent and illuminating fashion. There are important issues on which further illumination would have been welcomed. For example, there is the very interesting observation (p. 192) that the system of slash and burn "is really economic and effective provided [only] there is enough land to permit fallow periods of sufficient length." This is compared to what kind of agriculture, using what kinds of inputs—conventional or nonconventional—on the intensive margin? Does the shortening of the fallow and the recent first appearance of artificial fertilizer in tropical Africa imply that "free land" is coming to an end? Surely there must be some point at which intensive agriculture using new seed varieties—as is now happening in Asia with such remarkable results—will displace slash and burn agriculture, even if land continued plentiful. Too bad also that the authors did not draw on their wide experience to illuminate the currently very topical and related issue of how much mechanization really makes sense in tropical agriculture. They observe (p. 216) that "labor is seldom a limiting factor" but are ambivalent on the question of mechanization where multiple cropping is possible and seasonal labor shortages occur; it would have been helpful to have a fuller appreciation of the difference between economic and physical feasibility.

In the two chapters that follow (7 and 8) K. L. Bachman, R. P. Christensen and P. M. Raup address the troublesome issues of optimal farm size, land reform, and agricultural development. Bachman and Christensen, after what amounts to a not terribly successful short introduction to production theory,

deal with a survey of the major implications of scale and size on static productive efficiency and technological change in agriculture. This reader did not find the conceptual apparatus very helpful, but the literature surveyed, the bibliography cited, and the extensive practical experience brought to bear, all serve to illuminate substantially some rather complex issues. It is highly instructive, for example, to note, on the static side, the empirical evidence of greater productivity per crop acre on medium and large-scale plots, contrasted with the greater productivity per acre, due to multiple cropping, on smaller plots. Similarly, on the dynamic side, with respect to the existence of a much weaker relationship between size and technological change than one would expect due to the government's role in performing those few productive functions which require size.

It is nice to have one's prejudices about the doubtful value of general mechanization reinforced by reference to the relatively small number of simultaneous standard operations required and the consequent heavy burden on coordination and scheduling even under state farm or cooperative arrangements. Understandably not very many questions are answered and not all can even be raised. The usefulness of the proposed taxonomy as among small, dual-sized, and large is not demonstrated. While this reviewer wouldn't go as far as critic S. L. Barraclough who sees no hope of saying anything useful on issues of size and scale as long as other parameters are in flux, it must be admitted that many of these other factors may dominate so completely that easy generalizations assume unusually heroic proportions.

One important dimension of the size issue neglected by Bachman and Christensen but dealt with by Raup is the impact of size on the generation and channelization of agricultural saving. Raup's emphasis on the impact of land reform on the accretionary, nonspectacular quality of capital accumulation, e.g., livestock, housing, fencing, drainage, and road construction, is well taken. He rightly emphasizes not only the conventional importance of stable expectations for production incentives but also the unconventional point about the impact of additional investment opportunities, inside as well as outside of agriculture, on the *ex ante* consumption function. The Raup piece moreover contains an excellent discussion of the importance of decentralized decision making in the aftermath of land reform, not only from the point of view of the greater flexibility of economic decision-making afforded by smaller size but also with respect to its longer-run impact on the social and political fabric of the society.

The Japanese historical experience demonstrates that a landlord/tenant system also can be made to retain the necessary incentives as long as the efficient-sized units of production coincide with the tenant family management unit, and the tenant share is a fixed percentage of total output and not subject to year-by-year landlord erosion. This is especially relevant when the gains from redistribution must be weighed against possible losses arising from the need to replace such other landlord functions as the provision of credit, storage, and information. Overall, the evidence seems to support Raup—not critic R. P. Dore—on the greater proneness of smaller producing units to adopt innovations—while here again, as in the static case, some of the social functions

of research, adaptation, and extension will necessarily have to be handled by some form of collective action.

Raup is on less sure ground, on the other hand, than Dore, in suggesting that land reform should not be undertaken in the early phases of development but can wait until the agricultural population is no longer vastly predominant. If a change in the size of the typical producing unit is indeed important in getting the agricultural sector and thus the economy moving, the suggestion that one should wait until the center of gravity has already shifted to nonagriculture—itself a symptom of success—seems like circular reasoning. But this is at worst a minor blemish on an excellent paper. Raup is to be especially congratulated for not succumbing to the temptation of listing all the other complementary steps which must be taken if land reform is to be successful. Such a listing almost inevitably deteriorates into a discussion of overall agricultural development.

There follows a chapter on food and nutrition by M. C. Burk and Mordecai Ezekiel which is a rather straightforward statement on the subject emphasizing the many pitfalls attending nutritional information and interpretation; missing is adequate attention to the mental health implications of undernourishment among preschool children and any to the impact of nutritional inadequacy on labor productivity.

Chapter 10, by J. C. Abbott, turns the spotlight on the important but nevertheless much neglected subject of marketing institutions. The focus of his contribution is on the causes and consequences of the often encountered phenomenon of undue monopsony power facing the individual agricultural producer in developing countries. The main cause cited is that there is customarily too much product differentiation and buyer attachment for any kind of workable competition to survive. At first blush, this does not seem terribly convincing in light of the importance of fairly homogeneous food staples, tropical raw materials, and fruits in the typical agricultural product mix. Wouldn't it be easier to put the blame on the typically highly imperfect market for everything from information to credit. Before we take Abbott's advice and resort to forced government procurement as a device for breaking up the inequality of private bargaining power in the market, we should recall what the deadening hand of an inflexible bureaucracy can do. There are likely to be more efficient alternatives available—mainly dealing with improving the competitiveness of various markets at the margin.

Chapter 11 by G. S. Tolley and G. D. Gwyer is a well-argued professional piece, the only one dealing with many of the prominent open economy dimensions of the agricultural development problem. It emphasizes the supply side of the issue, perhaps in reaction to the virtually exclusive demand emphasis of the early postwar period. Unfortunately the promising 5-sector breakdown presented early in the piece remains just that. To attempt any rigorous multi-sector analysis is admittedly difficult—in fact, anything beyond three heterogeneous sectors becomes quickly unmanageable—but the Tolley-Gwyer 5-sector breakdown remains under-utilized even in a qualitative sense. Nevertheless, the authors have managed to put their finger on what this reviewer believes to be the basic area for fruitful future exploration and research, i.e.,

the mutual interaction between agriculture, industry, services and trade, with the further potentially very instructive differentiation between food and cash crop exports. Their basic conclusion (p. 432) that, "even if agriculture is considered in an open economy, efforts to increase productivity in food production should have high priority in development planning" is fast becoming the conventional wisdom—though the assertion that technical progress in the export-cash crop sector benefits only the consumer in the developed country is less convincing.

Stephen Lewis' chapter on agricultural taxation (Ch. 12) is, as we might expect, highly competent, thorough, and lucid. The canvas attempted is perhaps too large and the treatment of each subject consequently a bit sketchy, but this does not detract from the merits of the survey. Since I agree with virtually everything Lewis has to say on the important subject of agricultural taxation, let me simply note a few minor shortcomings. One is the relative neglect of incentive arguments, with respect to the effect of taxes on work, and on innovative activity, as well as on the propensity to save out of given incomes; this is especially true with respect to the discussion of the land tax. Another is the fact that the very interesting discussion of nontax policies affecting agricultural incomes does not differentiate between alternative income redistribution beneficiaries and, consequently, alternative saving/investment patterns resulting in each case. If there is a third, it is Lewis' unwillingness to take a more forthright stand on the pros and cons of export taxation. But these are minor quibbles. This is a thorough and highly skilled contribution—without sacrifice of freshness or ingenuity. Lewis' characterization of an increase of indirect taxes on manufactured goods as the collection of taxes already paid by the agricultural sector to the non-agricultural sector is a case in point. This is a highly accurate description of a phenomenon typical of many developing countries which for one reason or another—by design or accident—tax agriculture indirectly.

The volume concludes with contributions by Raj Krishna on agricultural price policy (Ch. 13) and by E. M. Ojala on programming agricultural development (Ch. 14). As far as this reviewer is concerned, the piece by Krishna is of such superior quality and so much needed in the literature to provide justification for this volume all by itself. It is a very wise piece, adroitly mixing theoretical acumen and practical experience to fashion a guide to perhaps the most crucial contemporary policy issue in developing agriculture. Krishna reminds us of the triple purpose of agricultural price policies (increased production, changed product mix, increased marketed share) as well as some of its less obvious—and in practice, most often neglected—dimensions. Among these is the need for multi-year price support commitments, the problem of upward drift inherent in a moving average price norm, the importance of sufficiently high input elasticities if the benefits are not to be "passed on," the possibility (contrary to T. W. Schultz) of using P.L. 480 imports to support a price support scheme rather than destroy it. Krishna's precise recipe on how to set support price, i.e., his bulk-lining principle is, at best, unclear; he gives short shrift to the administrative as well as the fiscal problems attending storage; and unlike Lewis, he does not pay enough attention to government's non-fiscal

impact on agriculture's terms of trade. But his is the best and most lucid statement on this whole set of issues I have come across. The price elasticity of output may be lower than other relevant elasticities, but the contrasting record of the 50's and 60's in such countries as Pakistan lends support to the notion that his price policy is as close as we have yet come to anointing "the" essential condition for sustained progress from among the long list of agricultural "inputs."

In the final chapter E. M. Ojala surveys the related planning and programming literature. The agricultural capital-output ratio is discussed with a proper appreciation for the important role of non-investment policies, but this reviewer agrees with critic Papanek that resources planning with given parameters and planning for parameter change are inadequately separated; agriculture is properly related in a general way to the rest of the developing economy, but important intersectoral relationships are given short shrift; the importance of utilizing the market mechanism as a mobilization device in agriculture is acknowledged, but the practical danger of concentrating too many energies on detailed formal planning are ignored.

This is a valuable addition to the literature on an important subject. It provides an excellent bibliography on the various major facets of agricultural development as well as a guide to future research. One could point to some notable omissions, e.g., the credit system, the application of project analysis techniques, the relevance of local agricultural organization at various stages of agricultural development or the future of agricultural trade among developing countries. But the more telling shortcoming is something for which we cannot hold the editors or the authors responsible, namely, it exposes the still considerable state of our ignorance on the subject of agricultural development. Thus we have to settle for an enumeration of "factors in agricultural development," rather than building blocks in a general explanatory framework. We are not yet able to analyze effectively economic growth as an organic process in which the agricultural sector, interacting with the rest of the economy and the outside world, plays out its multifaceted historical role.

GUSTAV RANIS

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### Population; Welfare Programs; Consumer Economics

*Inequality and Poverty.* Edited by EDWARD C. BUDD. New York: W. W. Norton & Co., 1967. Pp. xxxiv, 217. \$6.00; paper, \$1.95.

*Permanent Poverty: An American Syndrome.* By BEN B. SELIGMAN. Chicago: Quadrangle Books, 1968. Pp. xi, 238. \$6.50.

These two books counterbalance each other nicely. Both are concerned about the shape of the income distribution. One is passionate; the other is calm. One is good social criticism; the other is good economics. One is designed for the concerned citizen; the other is designed for academic use.

*Permanent Poverty* describes the history of poverty, past programs to eliminate poverty, the groups who are currently poor, and the political infighting that has accompanied the War on Poverty, but the book is essentially a cri-



tique of current poverty programs. Seligman subscribes to the culture of poverty school of analysis. Programs with an economic orientation fail since they fail to deal with the culture of poverty. Sociology and psychology conquer economics.

*Inequality and Poverty* looks at poverty as an economic problem. It provides a good collection of economic essays on the goal of income equality, the measurement of inequality, the determinants of inequality, combatting inequality, and poverty. An attempt has been made to find famous men with conflicting points of view. James E. Meade, Bertrand De Jouvenel, Henry C. Wallich, R. H. Tawney, and Milton Friedman hardly agree on the goal of equality. The book is designed to introduce the reader to empirical evidence about the distribution of income and wealth and to economic analysis of the income distribution. Except for direct income redistribution very little emphasis is placed on how the income distribution can be changed.

Seligman contends the current policies, appropriations, political commitments, and social institutions are not capable of eliminating poverty. He is undoubtedly correct. History has made many of his specific conclusions wrong, however. Although the book was published in 1968 most of the empirical data end in 1964. Low unemployment and rapid growth do make a difference. In his analysis South Bend, Indiana, is a major example of how economic forces can create a permanently depressed area. Before Studebaker shut down in Christmas of 1963 there were 81,000 employees in South Bend. By 1967 there were 95,000 employees. Despite a severe economic shock, rapid growth succeeded in returning South Bend to prosperity. This is fortunate for the country, but unfortunate for his thesis. Economic growth will not eliminate poverty, but it does eliminate the specter of massive unemployment from technological progress.

There is enough variety in *Inequality and Poverty* for anyone's taste. Most of the articles are well known. My favorite is R. H. Tawney on "Equality." I find it much harder to agree with either the values or economics embedded in three articles by Milton Friedman. Friedman suggests: (1) Individuals ought to be paid in accordance with the production resulting from their work, inherited abilities, and inherited wealth. (2) The actual income distribution reflects marginal products except for distortions introduced by government regulations. (3) Consequently the personal income tax should have a flat rate above the exemption level. (4) The negative income tax should be substituted for all current welfare programs.

LESTER THUROW

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*Economic Analysis for Health Service Efficiency.* By MARTIN S. FELDSTEIN. Amsterdam: North-Holland, 1967. Pp. viii, 322. \$14.00.

At a time of rapidly rising medical costs and increased governmental responsibility for financing medical care, this study of the British National Health Service is a welcome, and much needed, addition to the medical economics literature. It is, in the reviewer's opinion, by far the best and most comprehensive empirical analysis of the economics of hospital care.

Feldstein has two major concerns. The first is to estimate relevant decision-making parameters. He uses least-squares regression analysis to investigate economies of scale, determinants of capacity utilization, and short-run marginal costs. This represents a valuable contribution to the problem of measuring the technical efficiency of production. The second major concern is to improve the planning and use of health care resources on an aggregate level. He approaches this problem by developing and estimating a comprehensive structural model incorporating alternative methods of providing health care.

One of the most significant contributions of the microeconomic portion of the study is Feldstein's analysis of interhospital cost differences. He finds that variations in the composition of cases treated by hospitals account for approximately 30 per cent of the variation in hospital costs. For this reason it is extremely important to standardize case-mix before analyzing hospital costs.

The author's estimation of the short-run marginal costs of providing hospital care has some important implications for utilizing available resources more effectively. He finds that hospitals tend to operate in the area of falling short-run average costs. Hence he observes that average costs are usually higher than marginal costs. Since costs per case could be reduced by increasing capacity utilization, Feldstein also investigates the determinants of capacity utilization. He finds that an increase in hospital budgets, especially for medical staff, would lower costs per case treated by increasing the intensity with which available beds are used.

One shortcoming which detracts from the empirical analysis is the absence of a theoretical development of hospital motivation. Feldstein specifically rejects profit maximization but does not propose alternative hypotheses of output determination such as expanding output until (1) total cost equals total budgeted expenditures, (2) average cost is a minimum, or (3) physical capacity is reached. The absence of a theory of output determination particularly detracts from estimation of the long-run average cost curve. Since Feldstein argues that plant size is exogenously determined, estimation of the long-run average cost curve rests on the implicit assumption that output is set at the level where short-run and long-run average cost curves are tangent. Otherwise, observed points would not lie on the long-run curve. There is no *a priori* reason, however, for believing that hospitals pursue such a policy of output determination. A theory of hospital motivation would also improve the estimation of the production function. Without a theory of input determination, Feldstein has to fall back on the unsatisfactory assumption that all inputs are exogenously determined.

The principal contribution of the portion of the book on aggregate planning is a comprehensive structural model of the interrelationships among hospital, home nursing, midwifery, and general practitioner services. It enables the author to show how variations in the quantity and distribution of facilities and expenditures affect the pattern of utilization of various types of health care.

One of his most interesting findings concerns the relationship between supply and manifest demand (as measured by admissions and waiting lists). Within the range of observation, manifest demand for bed days rises proportionately with available supply of beds. For this reason manifest demand is a poor basis for planning required facilities. It is somewhat disappointing that

the author does not develop alternative guidelines for determining an optimal quantity of resources to be allocated to medical care.

This study provides valuable insight into the multitude of problems incurred in the public provision of goods and services. By providing hospital administrators and physicians with information on relevant marginal costs of treating another patient in hospital or keeping a patient hospitalized a day longer, facilities can be used more efficiently. By providing national planning bodies with information on optimal-sized hospitals and utilization patterns resulting from various levels and distributions of facilities and expenditure, more efficient use of existing and future resources can be made. The author is to be congratulated for his success in applying rigorous economic analysis and econometric methods to the problem of achieving technical efficiency in an important public sector activity.

KAREN DAVIS

*Rice University*

*The Brain Drain.* Edited by WALTER ADAMS. New York: Macmillan Company, 1968. Pp. xiii, 273. \$6.95.

In contrast to the many journalistic, even xenophobic, writings about the international migration of talent and skills that have appeared in the last two or three years, this volume provides a reasonably balanced, reasonably dispassionate treatment of "the problem." The 18 contributors, representing nine countries and offering widely differing opinions, avoid the common tendency to indulge in questionable statistical gamesmanship. Nor do they view the brain drain as a major cause of war, famine, or underdevelopment. They recognize positive as well as negative consequences from migration of top-level manpower. And, they also refrain from assigning responsibility for the brain drain either to countries of origin or to countries of destination. There are, of course, exceptions on each point.

Although the book originated in a conference of economists at Lausanne in August, 1967, it seems to be pitched toward noneconomists and carries a strong policy emphasis. Economic theory is present in most essays, though seldom elaborated or discussed critically as it is brought to bear on high-level migration. There are few original empirical contributions in the volume and, with one or two exceptions, participants do not refer to relevant research which has been carried out within the last three or four years.

Following the brief hortatory preface by Paul Douglas, the papers are organized in five sections, the first two of which will be of greatest interest to economists.

In the first section, Walter Adams introduces "The Problem," holding the pejorative implication of the phrase "brain drain," to be justifiable. Stevan Dedijer then sets the brain drain in historical context, dealing primarily with the migration of intellectuals that was associated with the rise of European universities from the 13th to 15th centuries. "Modern" migration is described by Brinley Thomas, who indicates the changed nature of migration after World War II; he contends that elite migration of today is not beneficial to both sending and receiving nations as 19th century mass migration was. Al-

though he presents statistics for immigration to several developed nations, Thomas pays particular attention to Atlantic migration. He associates the U.K.-U.S. flow with a persistent dynamic shortage in the United States attributable to public research and development expenditures, and with public regulation of professional salaries in England. Next, Charles Iffland and Henri Reiben place the brain drain in multilateral perspective; they focus on the important intermediate position of European nations and conclude that a United Europe would not only substantially moderate the brain drains from Europe and the United States but also aid the development of the third world.

The second section, "In Search of An Analytical Framework," includes a provocative piece by Harry Johnson. Arguing from a "cosmopolitan" viewpoint, Johnson contends that international migration based on free individual choice is beneficial to the world. In a Pareto-optimum qualification, he links world improvement through migration to the condition that worldwide private benefits from migration must not be offset by uncompensated social costs to those who remain at home. Johnson concludes that potential social losses, particularly those occurring from unrealized externalities, are exaggerated. He also notes that informal compensation occurs in the form of remittances and technical aid, and he proposes additional, more formal, methods of compensation aimed at realizing the benefits of international migration.

Stressing distributional and social welfare effects, Don Patinkin and Kenneth Boulding both discard the notion that free movement of high-level manpower is necessarily beneficial to the world. They try to cut through the cosmopolitan-nationalistic dichotomy by suggesting that "nationalistic" policies may be in the best long-run interests of world welfare. Patinkin points out that fostering diversity and competition by strengthening national positions through restrictive emigration policies may be justifiable in terms of a mythical "world welfare function." Boulding concludes that equating human capital to physical and requiring national compensation for international transfers of human capital is not only impractical but open to demographic- and education-related objections. Furthermore, he feels that "widening gaps" among nations, which are in part linked to human capital transfers, should be a matter of concern; the long-run implications of such gaps are uncertain.

In another vein, Enrique Oteiza presents a general decision model for examining high-level manpower flows. He emphasizes differentials (or the comparative evaluation of influential factors at origin and at destination) as distinct from a more traditional approach which tries to isolate factors at origin "pushing" migrants and factors at destination "pulling" migrants.

The remainder of the *Brain Drain* volume consists of: a chapter by Charles Kindleberger on "Study Abroad and Emigration"; a miscellany of "case studies" (France, Greece, India, Africa, the European Common Market, and the underdeveloped countries); and "An Agenda for Action."

Kindleberger's uninspired contribution includes a number of suggestions for remedying foreign student failures (academic failures while in college in the United States, failure to return home following their study, and failure to utilize skills at home). Among the "case studies," Hla Myint's, subtitled "A Less Alarmist View," stands out, not only because it is more general, but also be-

cause Myint does a particularly good job of separating out the diverse issues that are often indiscriminately lumped under the brain-drain rubric. Also worth noting specifically is a typically ethnocentric, but delightful, French explanation by R. Mossé of why Frenchmen presumably do *not* migrate to the United States.

The concluding Agenda for Action lacks punch. Summary recommendations tend to be very general ("eliminate discrimination and bigotry," or "increase professional opportunity") and provide little basis for action. In part, the failure to reach consensus on more concrete remedial measures reflects the controversial nature of the topic discussed and the breadth of viewpoints represented at Lausanne. Given the divergent perspectives of the participants, it is unfortunate that this book does not include excerpts from conference discussions. Such excerpts would have strengthened the book, which makes its major contribution through the juxtaposition of differing viewpoints.

ROBERT G. MYERS

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# CORRECTION

When I prepared a review of Joseph M. Belth, *The Retail Price Structure in American Life Insurance* (March 1968), I was under the impression that Professor Belth had died. Having since learned that this is not the case, I should like to apologize for any annoyance or inconvenience which my error may have caused Professor Belth, his family, and his colleagues.

IAN M. DRUMMOND

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# CORRECTION

Three misprints appeared in M. Inagaki's review of E. S. Phelps, *Golden Rules of Economic Growth: Studies of Efficient and Optimal Investment* (June, 1968):

On page 559, line 17, "efficient" should be "inefficient."

On page 560, line 18, one of the  $x(t)$ 's has a subscript 3 instead of a 2.

In footnote 2, the third equation in the first sentence should read:

$$f(k, e^{(1-m)(\lambda-\rho)t}) = (F/L)e^{-[(1-m)\mu+m\lambda]t}$$

# TITLES OF NEW BOOKS

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## NOTES

### EDITOR'S NOTE

This is my last issue as managing editor. Professor George H. Borts, of Brown University, now takes over, and he has my very best wishes. The profession is fortunate that Borts has agreed to take on this responsibility, for he is highly competent in a wide range of areas covering economic theory, economic policy, and econometrics.

While the quantity of manuscripts has risen astronomically over the past several years, more importantly their quality has risen very rapidly, too. This has been great, but it has presented me with an increasingly tough problem of which ones to accept and which to reject. In these decisions I have made mistakes, but they have been minimized, I think, by the expert guidance I have had from members of the Board of Editors, and by the excellent comments and advice I have received from hundreds upon hundreds of economists, who have willingly given up some of their time to act as referees. I thank them all.

I am also deeply in debt to two people in our office whose services to the *AER* exceed my own. Miss Doris Merriam has been Assistant to three managing editors, over a period of 20 years, and in that capacity she has seen more issues through the press than she would like to remember; she has provided wise counsel to me and to others; and she has directed all operations with a sure hand. She has been our example of the "real pro." Mrs. Joyce Parker has served the *Review* for 10 years as secretary and keeper of the files, and she deserves a medal for having maintained her good disposition even when half buried under tons of manuscripts and mail. I am also grateful to my wife, Yvette, who, by assuming the duties of book review editor for six years, relieved me of what would have been impossible additional burdens, and who in the bargain didn't cause any trouble. Miss Jane Ladd, who was my assistant for two years when Doris Merriam temporarily escaped to the Peace Corps, filled in most ably. We are now, at different ages but with identical nervous twitches, retiring with only one request: "Please, Don't Send Us Any More Manuscripts—Let George Do It."

JOHN G. GURLEY

The incoming managing editor of the *American Economic Review* requests that two copies of each manuscript be submitted to him: Dr. George H. Borts, Department of Economics, Brown University, Providence, R.I. 02912.

The name of the *Journal of Economic Abstracts* will be changed to the *Journal of Economic Literature*, effective January 1, 1969. The new journal will be expanded to contain articles reviewing the literature, book reviews, and bibliographical listings formerly in the *American Economic Review* in addition to the material that has been in the *Journal of Economic Abstracts*. The *JEL* will be included in the subscription of the *AER*, as has been the *JEA* since 1966. Questions concerning contents of the *JEL* and material formerly prepared for the *JEA* should be sent to: Professor Mark Perlman, Managing Editor, *Journal of Economic Literature*, P.O. Box 7320, Oakland Station, Pittsburgh, Pa. 15213. For an extra copy of the journal a separate order should be placed with the American Economic Association, 629 Noyes St., Evanston, Ill. 60201.

## A HISTORICAL NOTE FROM THE PRESIDENT

Following the events which took place in Chicago during the week of the Democratic Party Convention I received large numbers of telephone calls, letters, and petitions from our members urging us to move the 1968 meeting, scheduled for Chicago, to another city. There were a smaller number of communications on the other side. The question whether to stay in or move from Chicago therefore came to involve an active decision. The necessity for a decision was reinforced by the decisions of our sister associations—the sociologists to boycott Chicago for ten years, the psychologists to move their 1969 meeting, and finally the historians' decision to move their meeting which was scheduled at the same time as ours.

I was in Montreal at the Congress of the International Economic Association from September 2-6, and took the opportunity provided by the presence there of a considerable number of our members to call a special, informal meeting of members of the A.E.A. to discuss the matter. A variety of views were expressed, and a straw vote at the end of the meeting resulted in the following ballot: 43 voted to move from Chicago, and 15 voted to stay; 34 said they would boycott the meeting if it was held in Chicago, and 24 said they would not boycott the meeting. Even though this was only about 0.5 per cent of the membership, it was suggestive of the depth of feeling involved.

Harold Williamson, our Secretary, and I therefore decided to meet in Evanston, at the offices of the Association, on September 7, with representatives of the Chicago Arrangements Committee, the Convention Bureau and the hotels. In the meantime we had received invitations from two other cities and we had polled all available members of the Executive Committee by telephone or cable. The vote was evenly split.

We also consulted the other societies with which we have joint meetings; one society probably would wish to move, and three to stay. In light of the split vote of the Executive Committee the responsibility for the decision rested with me. Immediately after the meeting, then, I made my decision and wrote the following letter, which was sent out to the membership.

Dear Colleagues:

The events in Chicago during the Democratic Convention, and especially the police action as witnessed on television, have exploded a wave of shock through the minds of men, and created a sense of moral anguish, which I have shared, and which has not left our Association unmoved. We have had to make a decision, therefore, on whether to move the December 1968 meeting, scheduled for Chicago, to some other city. The Executive Committee of the Association has voted, by telephone canvass, 5 to move and 5 to stay; one member could not be reached. The decision therefore has become my personal responsibility, as President of the Association. I have canvassed opinion as widely as possible. It would be feasible, though difficult, to move to another city, and it is likely that a clear majority of our members would support such a move. Furthermore, a meeting in Chicago may be boycotted by a considerable number of our members, for reasons which I personally respect and share.

Nevertheless, my decision is to hold the meeting in Chicago, and not to move it, because I believe that the meeting can be used, more effectively, in Chicago, as a fulcrum to help move the future rather than as a stick to belabor the past. I propose that we devote time, outside the formal program, to a searching discussion of the agonizing discontents of our world, along with representatives of the city, with the object of asking ourselves, both as professional economists and as citizens, what we can do towards making the future better than the past. If we can turn the steam of our legitimate anger and anguish into some engine of solid proposals for social change, the chance for a better future is enhanced. I hope my friends will forgive this decision, and my foes will refrain from applauding it. I will welcome any communications in the ensuing weeks which will help us in organizing constructive discussions at the meetings. And I hope my successors will not have to make decisions as difficult as this one.

The following supplemental letter was sent out later, and may help to clarify some of the issues.

A special letter from the President of the American Economic Association to those members who have urged us to move the December 1968 meeting away from Chicago.

Dear Colleagues:

There are so many of you that I cannot reply individually. Many of you will feel, and I would not blame you for so feeling, that I have let you down, especially as, in our own jargon, our Utility Functions are so similar. I have no taste for elaborate self-justification. Nevertheless, this is one situation in which the reasons for an act were more important than the act itself, and you deserve to know some further considerations which affected my decision.

The problem, again in our economic language, is the nature of the moral production functions—that is, what inputs produce what outputs? We all want to see a massive change in human behavior and institutions, away from violence, cruelty, malevolence and injustice towards a more gentle, benevolent, and just world. This is the output we want, but if we are honest as social scientists we must admit that there is much that we do not know about the inputs that are most likely to produce this result.

The history of economic sanctions, for instance, which still largely needs to be written, suggests at least that indirect sanctions—hurting A in the hope that he will hurt B enough to change B's behavior—are likely to be ineffective. I become skeptical, therefore, on reflection about the benefits, in terms of an attempt to change political structures and behavior, of the economic sanctions involved in changing the place of meeting.

Some costs of a move from Chicago also loomed larger in my mind as I moved towards a decision. The probability of legal action against the Association did not seem great, though, because of a lack of precedent the legal status of a letter of intention to hold a meeting at a certain time and place is obscure. Nevertheless there would be a cost in terms of a destruction of trust in understandings given, a subtle but fragile structure on which much of our social organization depends. Another cost presented itself to me in terms of anxiety about the widening gap, in understanding and trust, between the academic community and the rest of society. This may have been brought about by a mainly random process involving the selection of occupants of powerful roles. It is a major task of the academic community, however, to reduce randomness, even at some cost to itself. I feared that moving the meeting would have contributed to widening this already dangerous gap.

On the other side of the coin, the decision to stay in Chicago may take a little pressure off those who are content with the present organization of violence, whether internal or external, and this I counted on the other side as a real cost of the decision. Here, the independent decision of other societies to move from Chicago made the decision to stay morally easier, if psychologically harder. There are moral as well as economic externalities. The decision to stay in Chicago should not be construed in any way as a criticism of those who decided to leave, and I hope it can be seen as part of a general pattern of creative protest.

Some of you may legitimately feel that my decision was so much in error that you will boycott the meeting. If so, I suggest that such individual action will be most effective if a personal letter is sent to the mayor's office, with a copy to me, so that we can form some estimate of the number of people affected.

The value of the decision will depend very much on what happens at the meeting. We will reserve rooms from 4:30–6:30 every afternoon, and from 9:30 on the Sunday evening of the meetings for special discussion sessions. These will not be programmed, and all members will be free to express themselves. Sessions on special topics may be organized by request.

In response to many petitions and communications a further vote of the executive committee was taken in early October. The vote did not justify a change in the decision to remain in Chicago.

KENNETH E. BOULDING  
*President*  
*American Economic Association*

## AER MANUSCRIPTS

The following manuscripts, exclusive of comments and replies and in addition to those listed in previous issues, have been accepted for publication in subsequent issues of the *American Economic Review*:

B. T. Allen: Concentration and Economic Progress: A Note

S. W. Arndt: Customs Union and the Theory of Tariffs

Orley Ashenfelter and George Johnson: Bargaining Theory, Trade Unions, and Industrial Strike Activity

R. U. Ayres and A. V. Kneese: Production, Consumption, and Externalities

M. J. Beckman and Ryuzo Sato: Aggregate Production Functions and Types of Technical Progress: A Statistical Analysis

Vittorio Bonomo and Charles Schotta, Jr.: A Spectral Analysis of Post-Accord Federal Open Market Operations

Gardner Brown, Jr. and M. B. Johnson: Public Utility Pricing and Output under Risk

J. M. Buchanan: External Diseconomies, Corrective Taxes, and Market Structure

E. R. Canterbery: Exchange Rates, Capital Flows, and Monetary Policy

V. K. Chetty: On Measuring the Nearness of Near Monies

M. R. Daniels: Differences in Efficiency Among Industries in Developing Countries

E. G. Davis: A Modified Golden Rule: the Case with Endogenous Labor Supply

A. C. Fisher: The Cost of the Draft and the Cost of Ending the Draft

R. J. Gordon: \$45 Billion of U.S. Private Investment Has Been Mislaid

W. P. Gramm and R. H. Timberlake, Jr.: The Stock of Money and Investment in the United States, 1897-1966

Helmut Hagemann: Reserve Policies of Central Banks and their Implications for U.S. Balance of Payments Policy

J. G. Head and C. S. Shoup: Excess Burden: The Corner Case

H. M. Hochman and J. D. Rodgers: Pareto-Optimal Redistribution

Stephen Hymer and Stephen Resnick: A Model of an Agrarian Economy Including Non-agricultural Activities

F. C. Jen and Lawrence Southwick, Jr.: Implications of Dynamic Monopoly Behavior

G. G. Kaufman: More on an Empirical Definition of Money

David Levhari and T. N. Srinivasan: Durability of Consumption Goods: Competition versus Monopoly

J. R. Melvin: Demand Conditions and Immiserizing Growth

Jan Mossin: A Note on Uncertainty and Preferences in a Temporal Context

E. O. Olsen: A Competitive Theory of the Housing Market: Some Policy Implications and Testable Hypotheses

Sam Peltzman: The Structure of the Money-Expenditures Relationship

C. D. Phelps: Real and Monetary Determinants of State and Local Government Capital Outlays for Highways, 1951-1966

Joel Popkin: The Determinants of the Foreign-Domestic Investment Mix of U.S. Manufacturers

R. J. Ruffin: Tariffs, Intermediate Goods, and Domestic Protection

J. M. Schaeffer: Clothing Exemptions and Sales Tax Regressivity

M. P. Todaro: A Model of Labor Migration and Urban Unemployment in Less Developed Countries

J. H. Wood: Expectations and the Demand for Bonds



## TEST OF UNDERSTANDING IN COLLEGE ECONOMICS

Pursuant to a suggestion by the Association's Committee on Economic Education, a Test of Understanding in College Economics has been developed and published by the Joint Council on Economic Education, and is now available from The Psychological Corporation, 304 East 45th Street, New York, New York 10017. It is in two parts. Part I, emphasizing macroeconomics, is on the content of a typical first semester of college economics. Part II, emphasizing microeconomics, is for the typical second semester. Two equivalent forms, A and B, are available for each Part. Each of the four forms can be administered in one class hour. Comparative data for a national sample of students at 54 American colleges are included in an accompanying Manual. Specimen sets of all four forms, the Manual, and scoring keys cost \$4.00. A package of 25 reusable test booklets is \$7.50 (\$7.00 in orders of ten or more packages). A package of 50 answer sheets is \$3.00 (\$2.70 in orders of ten or more packages).

The Test was prepared under supervision of a committee consisting of G. L. Bach, William G. Bowen, Paul L. Dressel, Rendigs Fels, R. A. Gordon (1965-67), B. F. Haley (1967-68), Paul A. Samuelson, and George J. Stigler.

One major objective is to provide a widely accepted measurement instrument that will facilitate comparison of the effectiveness of alternative teaching approaches and materials on different campuses. The AEA Committee on Economic Education (G. L. Bach, Chairman, Stanford University) will appreciate being advised of the results of such experiments.

*Announcements*

The Federal Reserve is putting renewed stress on the need for improving the scope and quality of measures of price change. This is being attempted in order to permit a better understanding of the forces leading to such changes, and the impact of alternative monetary and fiscal policies on the price level.

To accomplish these objectives, the Board has initiated a broad research program focusing on the conceptual and operating problems in the development of price measures needed for policy formulation. For this purpose, the services of a panel of distinguished scholars have been enlisted to work with the Board's staff in encouraging additional research in the area of prices. In some cases, it may also be possible for the Federal Reserve to devote a limited amount of financial resources toward the initiation of price research projects by private individuals which otherwise could not be started.

The interests of the panel, and of the Federal Reserve, are not limited to any one area of research, but range over a wide variety of topics. For information on the Committee and its activities, or to inquire about financial support for research projects, write to Alexander J. Yeats, Secretary, Federal Reserve Board Committee on Price Measurement, Board of Governors of the Federal Reserve System, Washington, D.C. 20551.

A Visiting Lecturer Program in Statistics has been organized for the sixth successive year. The program is sponsored jointly by the principal statistical organizations in the United States, the American Statistical Association, the Biometric Society and the Institute of Mathematical Statistics. The National Science Foundation provides partial financial support. Leading teachers and research workers in statistics—from universities, industry and government—have agreed to participate as lecturers. Lecture topics include subjects in experimental and theoretical statistics, as well as in such related areas as probability theory, information theory and stochastic models in the physical, biological, and social sciences. The purpose of the program is to provide information to students and college faculty about the nature and scope of modern statistics, and to provide advice about careers, graduate study, and college curricula in statistics. Inquiries should be addressed to: Visiting Lecturer Program in Statistics, Department of Statistics, Mathematical Sciences Building, Purdue University, Lafayette, Indiana 47907.

Authors of papers for possible inclusion in the Medical Care Section Program of the next annual meeting of the American Public Health Association (November 11-14, 1969

at Philadelphia, Pa.), may obtain standard abstract forms from Dr. Donald C. Riedel, Yale University School of Medicine, 60 College Street, New Haven, Connecticut 06510. Two types of papers will be considered: research reports and descriptions of programs or demonstrations. The deadline for submitting abstracts is April 15, 1969. Those whose papers are selected for the program will be notified in early June.

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*Dissertation Research Award Program for 1969.* The Awards Committee of the Council on Consumer Information has set a February 1, 1969 deadline for submission of papers to be considered for the award of \$100. The competition is open to graduate students and recent graduates reporting dissertation research on consumer problems completed in 1967, 1968 or 1969. Each paper should be prepared in professional journal form and should not exceed 15 typed, double-spaced pages in length. The authors of outstanding papers will be invited to present their papers at the annual conference and all papers will be considered for publication in the *Journal of Consumer Affairs*. Five copies of the entries should be mailed to the chairman, Dr. Marguerite C. Burk, Department of Agricultural Economics, University of Minnesota, St. Paul, Minnesota 55101. Other members of the Awards Committee are Dr. Mabel Rollins, of Cornell University, and Dr. Barbara Reagan, of Southern Methodist University.

#### *Deaths*

Karl L. Anderson, Middlebury College, July 1968.

Warren B. Catlin, professor emeritus of economics, Bowdoin College, July 10, 1968.

Frank Cist, fall 1967.

John W. Cordell, associate professor of economics, University of Arizona, January 23, 1968.

Hubert H. Frisinger, Toledo, Ohio.

Challis A. Hall, Jr., professor of economics, Yale University, October 1968.

Raphael Margolin, June 11, 1968.

Miguel Sidrauski, assistant professor of economics, Massachusetts Institute of Technology, September 1, 1968.

#### *Retirements*

W. Ellison Chalmers, professor, department of economics and Institute of Labor and Industrial Relations, University of Illinois, September 1968.

Paul R. Olson, professor of economics, University of Iowa, July 1, 1968.

#### *Visiting Foreign Scholars*

Albert A. Breton, London School of Economics: visiting associate professor of economics, University of Washington, summer 1968.

Kevin Clinton, London School of Economics: visiting lecturer in economics, University of Maryland.

Carlos De Cugis, Bocconi University, Milan: visiting professor of economics, Wichita State University.

Nicos E. Devletoglou, London School of Economics: visiting professor of economics, University of California, Los Angeles, winter quarter 1968.

David Horwell, University of Southampton, England: visiting assistant professor, Northwestern University, fall 1968.

Alex P. Jacquemin, Université de Louvain, Belgium: visiting assistant professor of business, government and society, University of Washington, fall 1968.

Lud M. Stallaert, Netherlands Institute of Business, Breukelen, The Netherlands: exchange professor, College of Business Administration, University of Oregon, 1967-68, and visiting professor, spring 1969.

Vivian C. Walsh, Sir George Williams University, Montreal: visiting professor of economics, University of Washington.

*Promotions*

Jerald Barnard: associate professor of economics, University of Iowa.

Clifford M. Baumbach: professor of business administration, University of Iowa.

Dwijaraj Bhattacharya: assistant professor of economics, University of Toledo.

G. Knight Boyer: assistant professor of economics, USAF Academy.

Henry T. Buechel: professor of economics, University of Washington.

Kee Il Choi: associate professor of economics, College of William and Mary.

Don J. DeVoretz: assistant professor, department of economics and commerce, Simon Fraser University.

Margaret B. Dray: assistant professor of economics, Chicago City College—The Loop College.

Richard D. Duckworth: assistant professor of economics, USAF Academy.

Betty G. Fishman: assistant professor of economics, West Virginia University.

Robert Foster: associate professor of economics, Wichita State University.

William J. Frazer: professor of economics, University of Florida.

Martin A. Garrett, Jr.: associate professor of economics, College of William and Mary.

Eva Garzouzi: associate professor of economics, Ithaca College.

Herman L. Gilster: assistant professor of economics, USAF Academy.

Irving J. Goffman: professor of economics, University of Florida.

Robert G. Gough: assistant professor of economics, USAF Academy.

James A. Gross: associate professor of industrial and labor relations, New York State School of Industrial and Labor Relations, Cornell University.

John D. Guilfoil: associate professor of economics, School of Commerce, New York University.

James B. Herendeen: associate professor of economics, Pennsylvania State University.

James E. Hibdon: professor of economics, University of Oklahoma.

Fred C. Hung: professor of economics, University of Hawaii.

Hui-Min (Henry) Hwang: associate scientist in agricultural economics, University of Minnesota.

James Jeffers: associate professor of economics, University of Iowa.

Dudley D. Johnson: assistant professor of economics, Dartmouth College.

Jerzy F. Karcz: professor of economics, University of California, Santa Barbara.

Israel Kirzner: professor of economics, School of Commerce, New York University.

Philip A. Klein: professor of economics, Pennsylvania State University.

L. Emil Kreider: assistant professor of economics, Southern Illinois University.

L. F. Kristjanson: professor, department of economics and political science, University of Saskatchewan, Saskatoon.

Melvin Leiman: associate professor of economics, State University of New York at Binghamton.

E. Scott Maynes: professor of economics, University of Minnesota.

Daniel McFadden: professor of economics, University of California, Berkeley.

Robert R. Miller: associate professor of business administration, University of Iowa.

Michael Molitoris, Jr.: assistant professor of economics, USAF Academy.

Gerald L. Nordquist: professor of economics, University of Iowa.

George L. Perry: professor of economics, University of Minnesota.

Richard D. Raymond: associate professor of economics, West Virginia University.

Marcel K. Richter: professor of economics, University of Minnesota.

Warren C. Robinson: professor of economics, Pennsylvania State University.

Edwin L. Rogers: assistant professor of economics and business administration, University of North Carolina at Charlotte.

Robert J. Saunders: associate professor of economics, West Virginia University.

Larry Sgontz: associate professor of economics, University of Iowa.

Ahmad H. Shamseddine: assistant professor of economics, Elizabethtown College.

Calvin D. Siebert: associate professor of economics, University of Iowa.

Zane Spindler: assistant professor, department of economics and commerce, Simon Fraser University.

Bruno Stein: professor of economics, Washington Square College of Arts and Science, New York University.

Thomas C. Turner: assistant professor of economics and business administration, University of North Carolina at Charlotte.

Martin A. Ulrich: assistant professor, department of economics and commerce, Simon Fraser University.

Ingo Walter: associate professor of economics, University of Missouri—St. Louis.

Larkin B. Warner: professor of economics, Oklahoma State University.

Royce J. Watts: assistant professor of economics, West Virginia University.

Herbert D. Werner: associate professor of economics, University of Missouri—St. Louis.

Calman R. Winegarden: associate professor of economics, University of Toledo.

Shih-Yen Wu: professor of economics, University of Iowa.

Yeong-Her Yeh: associate professor of economics, University of Hawaii.

#### *Administrative Appointments*

Eric Axilrod: chairman, department of economics, Washington and Jefferson College.

Lowell R. Bassett: acting director, Institute for Economic Research, department of economics, University of Washington.

Frederick W. Bell, Clark University: chief, Branch of Economic Research, Bureau of Commercial Fisheries, Department of the Interior.

Philip M. Carroll, Colorado State University: professor and associate director, Defense Management Center, Continuing Education Division, College of Administrative Science, Ohio State University.

John J. Casson, Jr., The United Corporation: economist, Research Institute Investors Service.

Dale L. Cramer: head, department of economics, University of Alabama, succeeding R. M. Havens, who remains as associate dean for international programs and professor of economics.

Jon S. Cunningham: acting chairman, department of economics, Ohio State University.

Albert L. Danielsen: vice chairman, department of economics, University of Georgia.

Daniel E. Diamond: professor of economics and associate dean, School of Commerce, New York University.

William L. Dorries: chairman, department of economics, East Texas State University.

Walter L. Eisenberg: chairman, Faculty Council of Hunter College of the City University of New York.

Eugene F. Elander: associate professor and chairman, department of business, Atlantic Community College.

Robert J. Ellis: director, Business Research Bureau, Southern Illinois University

H. M. Gitelman, College of William and Mary: chairman, department of economics, Adelphi University.

William F. Hellmuth, Jr., Oberlin College: Deputy Assistant Secretary of the Treasury for Tax Policy.

Sidney Herman: assistant dean, College of Liberal Arts, Northeastern University.

John R. Hodges: chairman, department of economics, University of Missouri—Kansas City.

Charles Hoffmann: provost for the social sciences, State University of New York at Stony Brook.

Gerlof Homan, Bank of America, San Francisco: associate professor of economics and director, Bureau of Business and Economic Research, University of Oklahoma.

Graham M. Johnson: dean, School of Business Administration, East Texas State University.

Robert A. Kavesh, Graduate School of Business, New York University: chairman, department of economics, School of Commerce, New York University.

Stephen R. Lewis, Jr.: acting provost, Williams College.

Melvin Lurie: chairman, department of economics, University of Wisconsin—Milwaukee.

Robert A. Lynn: dean, College of Commerce, Kansas State University.

K. B. Marx: chairman, department of economics, School of Business, Western Illinois University, July 1, 1968.

Kenneth R. McCord: chairman, department of accounting, East Texas State University.

William L. Miller: chairman, department of economics, University of Georgia.

Charles T. Moore: assistant vice president for planning, University of Alabama.

Egon Neuberger: chairman, department of economics, State University of New York at Stony Brook.

Allan V. Palmer: chairman, division of economics and business administration, University of North Carolina at Charlotte.

Trezzie A. Pressley: chairman, department of marketing-management, East Texas State University.

Allan G. Pulsipher: assistant director of RETAP program, Southern Illinois University.

Melvin Rothbaum: director, Institute of Labor and Industrial Relations, University of Illinois.

Donald R. Sheriff: professor and director, Center for Labor and Management, University of Iowa.

Anthony Sinicropi: associate professor and associate director, Center for Labor and Management, University of Iowa.

Edward R. Sopiartz: acting chairman, department of economics, University of Toledo.

Louis Winnick: deputy vice president, National Affairs division, Ford Foundation.

### *Appointments*

Martin E. Abel, U.S. Department of Agriculture: professor of agricultural economics, University of Minnesota.

Bernhard J. Abrahamsson: associate professor of economics and business administration, University of Alaska.

Assibi O. Abudu: assistant professor of economics, University of Hawaii.

Arthur J. Alexander: economics department, The RAND Corporation.

Robert L. Allen, University of Oregon: professor of economics, University of Missouri—St. Louis.

Osama A. Al-Zand: research associate, department of agricultural economics, University of Minnesota; Minnesota-overseas assignment, Agency for International Development, Tunisia, 1968-70.

Takeshi Amemiya: associate professor of economics, Stanford University.

I. B. Anderson: assistant professor, department of economics and political science, University of Saskatchewan.

Kent P. Anderson: economics department, The RAND Corporation.

David B. Ashby: assistant professor of economics, University of Hawaii.

Thomas Baird, Louisiana State University: Fourth National Bank Distinguished Professor of Money and Banking, Wichita State University.

William Baird, Whittenberg University: associate professor of economics, College of Wooster.

Stephen E. Baldwin, University of Washington: visiting lecturer, department of economics, Heriot-Watt University, Edinburgh, Scotland.

Gilbert Banner, University of Tennessee: associate professor of economics, Knoxville College.

David P. Barkin: assistant professor, Washington Square College of Arts and Science, New York University.

Ronald Bearden: instructor in quantitative management science, University of Houston.

Douglas T. Beebe: assistant professor of economics, University of Georgia.

Lewis C. Bell, Western Kentucky University: professor of economics, West Virginia University, and fiscal consultant to the West Virginia Legislature.

Charles A. Berry: assistant professor, University of Cincinnati.

Richard E. Bilsborrow: lecturer, Washington Square College of Arts and Science, New York University.

Eleanor Birch: assistant professor of business administration, University of Iowa.

John H. Bishop: lecturer, Washington Square College of Arts and Science, New York University.

Erwin A. Blackstone: assistant professor of economics, Dartmouth College.

Walter Block: instructor in economics, State University of New York at Stony Brook.

Gary P. Brinson: instructor in business administration, Washington State University.

Robert Britt, Smith College: assistant professor of economics, West Virginia University.

Robert L. Brittingham: instructor in economics, Saint Louis University.

Ira Brous: assistant professor of economics, Ithaca College.

Joe E. Brown: professor of economics, University of Missouri—Kansas City.

John W. Budina, Jr., Stetson University: associate professor of business administration, Florida Technological University.

John E. Buehler, Florida State University: assistant professor of economics, University of Arizona.

Thomas W. Byarlay: instructor, division of economics and business administration, University of North Carolina at Charlotte.

A. Camacho: visiting associate professor, School of Business Administration, University of California, Berkeley.

Steven Canby: social science department, The RAND Corporation.

Douglas G. Carman, Southern Methodist University: assistant professor of economics, East Texas State University.

Stephen J. Carroll: economics department, The RAND Corporation.

Laurence C. Chau: assistant professor of economics, University of Hawaii.

Elizabeth M. Clayton, University of Washington: assistant professor of economics, University of Missouri—St. Louis.

Ann H. Coffey, Johns Hopkins University: assistant professor, Western Maryland College.

Robert Cohen, Brooklyn College: research economist, McGraw-Hill Publications.

William S. Comanor, Harvard University: associate professor of economics, Graduate School of Business; courtesy appointment, department of economics, Stanford University.

Salvatore Comitini: associate professor of economics, University of Hawaii.

Charles A. Cooper: economics department, The RAND Corporation.

William R. Cooper: instructor, department of economics, Northern Michigan University.

Taylor K. Cousins: assistant professor of economics, College of William and Mary.

Bud Crewdson, Upper Midwest Research Development Council: assistant professor and extension specialist of agricultural economics and agricultural extension service, University of Minnesota.

John R. Darling, Jr., University of Alabama: associate professor of marketing, University of Missouri.

Abraham S. David: visiting associate professor of economics and member of Carolina Population Center, University of North Carolina.

Paul M. Davis: assistant professor of accounting, University of Kentucky.

Edwin R. Dean: associate professor of economics, Queens College of the City University of New York.

Philip M. DeMoss: assistant professor of economics, University of Missouri—Kansas City.

Bruce F. De Vine: instructor in economics, Pomona College.

William M. Dickson, Western Washington State College: visiting associate professor, department of economics and commerce, Simon Fraser University.

William H. Dinkins: assistant professor of economics and accounting, University of Alaska.

Avinash K. Dixit: acting assistant professor of economics, University of California, Berkeley.

Richard Dusansky: assistant professor of economics, State University of New York at Stony Brook.

Brenda B. Eddy: instructor in business administration, Ithaca College.

Howard S. Ellis, University of California, Berkeley: visiting professor of economics, Pomona College.

Donald Epley: instructor in economics, Wichita State University.

John S. Evans: lecturer in economics, University of Alabama.

Richard A. Fey: assistant professor of managerial economics, College of Business Administration, Boston University.

Earl M. Foster: assistant professor of finance, College of Business Administration, Boston University.

Dale R. Funderburk, Oklahoma State University: assistant professor of economics, East Texas State University.

Subrata Ganguly: instructor in economics, University of Virginia.

Louis C. Gasper: assistant professor of economics, College of Business and Public Administration, University of Arizona.

Meredith B. Givens: Ford Foundation, manpower adviser to the Government of Ghana.

Nancy Gordon: acting assistant professor of economics, Stanford University.

Stephen Grace: instructor in quantitative management science, University of Houston.

Hugh R. Granade, University of Florida: assistant professor of economics, University of Tennessee.

David H. Greenberg, The RAND Corporation: special appointment to the President's Commission on Income Maintenance.

Douglas F. Greer: assistant professor of economics, University of Maryland.

Frank R. Grillo: assistant professor of economics, Brooklyn College of the City University of New York.

Roy J. Grohs: instructor in economics, Washington State University.

William D. Gunther: lecturer in economics, University of Alabama.

James D. Gwartney, University of Washington: assistant professor, Florida State University.

John F. Haneski, Purdue University: assistant professor of economics, University of Missouri—St. Louis.

Alvin J. Harman: economics department, The RAND Corporation.

Clark A. Hawkins, Florida State University: associate professor of economics and finance, University of Arizona.

Bonnie Hickie: instructor in economics, Wichita State University.

John J. Hooker, The Catholic University of America: associate professor of economics, University of Texas at El Paso.

Thomas D. Hopkins: assistant professor of economics, Bowdoin College.

E. Jay Howenstine, International Labour Office, Geneva: urban economist, U.S. Department of Housing and Urban Development, Washington, D.C.

Ching-ju Huang: visiting lecturer in economics and member of Carolina Population Center, University of North Carolina.

Joseph M. Jadow, Jr.: assistant professor of economics, Oklahoma State University.

Peter J. Kalman: associate professor of economics, State University of New York at Stony Brook.

John S. Kaminarides: assistant professor of economics, Arkansas State College.

W. E. Kamps: lecturer, department of economics and political science, University of Saskatchewan, Saskatoon.

Donald Keasing: associate professor of economics, Stanford University.

Peter E. Kennedy, Cornell University: assistant professor, department of economics and commerce, Simon Fraser University.

Virgil Ketterling: department of economics, University of North Dakota.

Hi Kim: assistant professor of economics, Lamar State College.

Robert J. Kirk, Iowa State University: assistant professor of economics, University of Missouri—St. Louis.

Erich Klinkmuller, University of Arizona: associate professor of economics, Saint Louis University.

James A. Knoblett, University of Tennessee: associate professor of accounting, University of Kentucky.

Joseph S. La Cascia: associate professor of economics, University of West Florida.

Helen Locke Ladd: visiting lecturer in economics, Dartmouth College.

Roland Laing: assistant professor of accounting, Ithaca College.

John Landon: instructor in economics, Case Western Reserve University.

Charles G. Leathers, West Texas State University: assistant professor of economics, University of Alabama.

Hayne E. Leland: assistant professor of economics, Stanford University.

Valdean C. Lembke: assistant professor of accounting, University of Iowa.

Henry Levin: assistant professor, Graduate School of Education; courtesy appointment, department of economics, Stanford University.

An-Yhi Lin, Wisconsin State University: assistant professor, Southern Illinois University.

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Michael Murray: assistant professor of insurance, University of Iowa.

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Mildred Pryor, University of Mississippi: assistant professor of management, East Texas State University.

George Psachoropoulos: assistant professor of economics, University of Hawaii.

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A. Ross Shepherd: associate professor of economics, University of Missouri—Kansas City.

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Raymond Struyk, Washington University: assistant professor of economics, Livingston College, Rutgers University; continuing on research staff, National Bureau of Economic Research.

Robert C. Stuart, University of Wisconsin and Russian Research Center, Harvard University: assistant professor of economics, Douglass College, Rutgers—The State University.

Abraham Subotnik, Stanford Food Research Institute: research associate, department of agricultural economics, University of Minnesota.

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Norman Sun, International Christian University: professor of economics, Temple University.

Jack J. Tawil: assistant professor of economics, University of Hawaii.

Azriel Teller, University of Illinois, Chicago: assistant professor, Temple University.

David L. Thomasson: assistant professor of economics, Sam Houston State College.

Alfred E. Toth: assistant professor of managerial economics, College of Business Administration, Boston University.

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Yien-I Tu, University of Calgary, Alberta: associate professor of economics, College of Business Administration, University of Arkansas.

Herman Van Wersch: research associate, department of agricultural economics, University of Minnesota; Minnesota-overseas assignment, Agency for International Development, Tunisia, 1968-70.

Justin Voss: instructor, department of economics, The American University.

Richard E. Wagner: associate professor of economics, Tulane University.

Joseph J. Walka: assistant professor of economics, College of Business & Public Administration, University of Arizona.

Charles Waldauer, University of Delaware: assistant professor of economics, Claremont Colleges.

S. E. Wallace: instructor, department of economics and political science, University of Saskatchewan, Saskatoon.

Dale Weigel: assistant professor of business administration, University of Iowa.

Arthur S. Weinberg: instructor in economics, Bates College.

Steven J. Weiss: assistant professor of economics, University of Toledo.

Paul Wells, University of Illinois: visiting professor, department of economics and commerce, Simon Fraser University.

David Whitcomb: cost analysis department, The RAND Corporation.

John P. White: logistics department, The RAND Corporation.

Robert E. Willard, Nevada Southern University: assistant professor of economics, University of Texas at El Paso.

Robert G. Williams: assistant professor, division of economics and business administration, University of North Carolina at Charlotte.

Barry D. Wood: instructor in economics, Northern Michigan University.

Max S. Wortman, Jr., University of Iowa: professor of management and industrial relations, University of Massachusetts.

Frank C. Wykoff, University of California, Berkeley: assistant professor of economics, Pomona College.

Donald J. Yankovic: assistant professor of economics, University of Toledo.

I. N. Yoon: associate professor of economics, Wichita State University.

### *Leaves for Special Appointments*

Abram Bergson, Harvard University: visiting professor of economics, Stanford University.

Thomas C. Campbell, West Virginia University: Ford Foundation grant, advisor to the Ministry of Economic Planning and Development, Government of Kenya, 1968-1970.

Marten S. Estey, University of Pennsylvania: labor economist, Council of Economic Advisers.

Robert E. Evenson, University of Minnesota: visiting professor of economics, Southern Methodist University.

William J. Frazer, University of Florida: returned from two year leave at Federal Reserve Bank of Chicago and University of Kentucky.

Joe R. Fritzmeier, University of Iowa: assistant to the executive vice president, American Institute of Certified Public Accountants.

Eliyahu Kanovsky, State University of New York at Stony Brook: fellow, Middle East Institute, Harvard University.

Max R. Langham, University of Florida: visiting professor of agricultural economics, University of Minnesota.

Robert Lekachman, State University of New York at Stony Brook: fellow in law and economics, Harvard Law School.

John N. McKinney, Simon Fraser University: visiting associate professor, Sacramento State College.

John M. Munro, Simon Fraser University: department of regional planning, Middle East Technical University.

Robert Piron, Oberlin College: UNESCO consultant to the Institute of Economic Development, Istanbul University, Turkey, fall 1968.

Gustav Schachter, Northeastern University: OECD consultant, Ankara, Turkey and lecturer in economics at Middle East Technical University.

Martin Segal, Dartmouth College: research staff, International Labour Organization, Geneva.

Larry Sgontz, University of Iowa: Joint Council on Economic Education, New York.

Robert E. Smith, University of Oregon: President's Committee on Price Stability, Washington, D.C.

Vladimir Stolkov, University of Illinois: visiting professor, New York State School of Labor and Industrial Relations, Cornell University.

Paul Wonnacott, University of Maryland: senior staff, President's Council of Economic Advisers.

### *Resignations*

Howard S. Dye, University of Arizona, June 30, 1968.

K. L. Gupta, University of Saskatchewan, July 1, 1968.

Toussaint S. Hočevár, Florida State University, September 1968.

Martin B. Johnson, University of Washington.

K. Laycock, University of Saskatchewan, July 1, 1968.

R. Nimeh, University of Saskatchewan, July 1, 1968.

Roger L. Ransom, University of Virginia.

K. J. Rea, University of Saskatchewan, July 1, 1968.

John A. Shubin, School of Commerce, New York University, August 31, 1968.

Melvin Stone, University of North Dakota.

Lee Van Zant, University of Texas at El Paso, June 1968.

### *Miscellaneous*

W. Robert Brazelton, University of Missouri—Kansas City: president, Southwestern American Association for the Advancement of Slavic Studies, 1968-1969.

Frank J. Smith, University of Minnesota: awarded the American Agricultural Economics Association's Distinguished Extension Program Award for 1968.



# ECONOMICS 1969

ECONOMICS

Fourth Edition

John A. Bove, Washington State University, and  
Robert E. Johnson, University of Missouri

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